Department of Conservation
Division of Recycling

Market Analysis for Recycled Beverage Container Materials: 2009 Update

Recycling Market Development and Expansion Grant Program

June 2009

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Executive Summary

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In the twelve months from July 2008, to June 2009, markets for recycled beverage container materials have seen both near historic highs, and lows. The economic downturn has taken its toll on beverage sales, and markets for recycled beverage container materials. While California's markets for recycled beverage container materials have always been dynamic, in the last year, they have been volatile.

The initial focus in writing this report was to emphasize the implications of these recycled material market conditions for the Recycling Market Development and Expansion Grant Program (grant program). However, during the time in which we wrote this report, the external environment changed drastically. When tasked with this report in October 2008, the economy was showing signs of stress, but it had not yet collapsed. California's budget situation was challenging, but it was not yet in crisis. In October 2008, the grant program had many projects in progress, and it was gearing up for four (4) more grant award cycles. Today, most grant work has been suspended, and funding for future grants is uncertain.

The State of California's own budget crisis overlays the volatile market dynamics. Several of the California Department of Conservation (DOC), Division of Recycling's (DOR) programs, defined in Section 14581, of the Beverage Container Recycling and Litter Reduction Act[1], were suspended in April 2009, due to unavailability of funds. The State Legislature has borrowed unredeemed beverage container recycling funds to help meet general fund program needs. In addition, beverage sales were down in 2009, reducing money going into the Beverage Recycling Fund. As this report is being written (June 2009), it is unclear what the disposition of many of the DOR's Section 14581 programs will be in fiscal year 2009/2010.

These economic dynamics created two significant DOR challenges – one external to the program, and one internal. First, as we noted in our previous market reports, external market conditions are dynamic. What was relevant in December 2008, is no longer as relevant in June 2009. This market uncertainty caveat is particularly true for this report, which covers one of the most volatile periods ever in the modern history of (1) recycling markets, (2) the State's finances, and (3) the global economy. Our approach to this challenge was to focus, for each of the four major material types, on how various factors in the marketplace influenced recycled material markets and conditions.

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[1] Section 14581 of the Act states that subject to availability of funds, the DOC shall expend moneys set aside in the fund for: handling fees, Community Conservation Corps (CCC), CCC grants, payments to cities and counties, grants for recycling and litter reduction, processing payments, public education, quality incentive payments (QIPs), market development and expansion grants, loan guarantees, market development payments (MDPs), recycling incentive payments, grants for recycling at parks and multi-family housing, and collection-focused grants.

The second challenge relates to the DOR's internal budget crisis. The original intent of this report was to provide the DOR, and potential grant applicants, with updated information on recycled beverage container material markets. This information was intended to help potential grant applicants focus their proposals, and assist the DOR as they reviewed and evaluated grant applications. To meet these objectives, this market report provides an overview of the current status of recycled beverage container material markets; California processing/reclaiming capacity today and in 2012; market issues; and new market alternatives and opportunities.

In writing this report, we were focusing on the market conditions for each of the ten beverage container material types, and the implications of those conditions on the grant program. As we finalized this report, funding for the grant program is, at best, significantly reduced. Thus, this third market analysis report reflects a blending of information and analyses that meet the original intent of the project, combined with discussions that reflect realities of the external and internal environment that the DOR faced, as of June 2009.

In each of the material-specific chapters, the New Market Alternatives and Opportunities sections identify projects and policies that we believe address current market issues. While these recommended projects and policies are reasonable suggestions from a program needs-based perspective, they may no longer be realistic suggestions from a Department budgetary perspective. Given the grant programs' reduced, and uncertain, funding, our recommended projects and policies represent more of a "wish-list", than a practical list of grant alternatives to consider.

The State's budget crisis does not change the nature of current market conditions; it only changes how the DOR is able to react to those conditions. Below, we provide a summary of the current market conditions and issues for each of the four major material types.

There are also bigger-picture factors that influence recycling and recycled material markets – some positively, and some negatively. It is impossible to evaluate today's market conditions without considering implications of the global economic downturn. Because recycled materials are essentially commodities, they react to the same market influences as wheat, pork bellies, steel, or any other commodity market. The economic downturn has reduced manufacturing, international trade, and consumer demand for most products, including beverages. On the positive side, a number of new business trends, such as green building and sustainability initiatives, create support for recycled material markets. We discuss these factors and trends in Section 7 of the report.

Aluminum

Aluminum beverage containers are the most recyclable, and most recycled, beverage containers in the Beverage Container Recycling Program. In 2008, the aluminum CRV recycling rate achieved its highest level since 1992. The 84 percent recycling rate achieved in 2008 represented a significant increase in aluminum recycling over the last few years – rebounding from a low of 70 percent in 2003. Aluminum beverage container sales have been relatively flat over the last several years, and aluminum has lost a significant market share to plastic.

The economic downturn has led to reduced demand, and reduced prices, for both virgin and recycled aluminum. Prices for recycled aluminum have been slowly recovering, but they are still far less than the near all-time high levels of the last two years. Over the last several months, some recyclers and processors have been stockpiling aluminum, as they wait for higher prices.

Aluminum prices are determined by the London Metal Exchange, and they reflect global

demand for primary aluminum, as well as energy costs. The vast majority of aluminum beverage cans recycled in California are shipped to aluminum smelters in the Southeast. Recycled aluminum is smelted into can sheet, and it is used to produce new aluminum cans. Aluminum beverage cans contain 40 to 50 percent post-consumer recycled content. While there are seasonal variations in demand for recycled aluminum, there is generally adequate capacity at smelting facilities to handle all of California's recycled aluminum cans.

Glass

Unlike the other three major beverage container materials, which have been on a roller-coaster over the last year, glass markets have been relatively stable. The key market concerns for glass have not changed over the last two years. While there have been improvements in glass processing, due in large part to support from the grant program, the low quality of single stream curbside glass remains a problem. Almost one-half of the glass recycled in the State is through curbside programs. The costs to clean and sort this glass so that it can be utilized by glass container manufacturers, fiberglass manufacturers, and other end-markets, are significant.

A related issue for California recycled glass is glass fines – those small pieces of glass left over after the screening process. The amount of glass fines going to landfills decreased between 2006 and 2008, again due to processing improvements. However, over 70,000 tons of glass fines are still being sent to landfills for no-value end-uses; such as roadbed, erosion control, lining ditches, and alternative daily cover.

While California glass markets are stronger than most parts of the country, there is a market imbalance between Northern and Southern California. The closure of two Southern California glass container manufacturing plants in 2004 and 2006 has resulted in a market void in the South State. Significant quantities of California recycled glass are being shipped, at great cost, to out-of-state glass manufacturers.

On the positive side for glass markets, the recycling rate increased in 2008, and glass container and fiberglass manufacturers increased utilization of recycled glass. In addition, there are a number of new high-value recycled glass markets, including bricks, countertops, and concrete products. The concrete products market may help alleviate some of the recycled glass market void in Southern California.

PET

PET is arguably the most dynamic of the recycled beverage container materials, in terms of markets. Recycled PET, and virgin PET, are global commodities. Prices for both forms of this plastic resin are determined by global factors such as oil prices, economic conditions, international trade policies, and feedstock supply and demand. California's recycled PET market continues to be strongly influenced by exports to China. In 2008, approximately 76 percent of California recycled PET was ultimately exported to China. This strong export market leads to a higher scrap price for recycled PET bales.

The fact that there even are PET reclaimers in California is a grant program success story. While the export market, among other factors, has made it extremely difficult to develop PET reclaiming capacity in the State, California currently has three (3) PET reclaimers producing recycled PET flake. There are a number of other businesses in various stages of establishing PET reclaiming facilities in California, including a bottle-grade facility, funded, in part, by the grant program.

In California, there is strong demand for recycled PET clamshell containers for produce and other food products. This market for recycled

PET has grown significantly over the last few years. There are a number of thermoforming companies located in California that produce PET clamshell containers, including two companies that utilize large quantities of recycled PET flake. Thermoformer demand for recycled PET flake is price and quality sensitive, creating a tenuous balance between supply and demand.

An issue with serious long-term implications for both PET and HDPE recycling is the growing use of chemical additives and differential barrier layers in plastic containers. This trend is making the carefully defined legacy plastics #1 to #7 resin code system, developed after much discussion in the 1990s, less and less applicable. While ASTM International (formerly the American Society for Testing and Materials) is currently reevaluating the resin coding system[2], the evaluation process could take several years. Barriers and additives are continuously evolving, resulting in increased recycling costs and creating challenges for recyclers, processors, reclaimers, and end-users.

HDPE

Even though the HDPE CRV recycling rate increased in 2008, the key market issue for HDPE remains lack of supply. The most common HDPE beverage container is milk jugs, which are not within the Beverage Recycling Program. HDPE is the one beverage container material for which more volume is recycled through curbside programs, than through buyback recycling centers.

While California's three HDPE reclaimers have always been challenged to obtain enough recycled HDPE to meet their capacity needs, current market conditions are difficult. Exports of California recycled HDPE to China are at an all-time high, making it extremely difficult for HDPE reclaimers to operate.

One consequence of California's strong export market for plastics is lower quality bales. This issue is amplified for HDPE, because many recyclers mix CRV plastic #3 to #7 containers in with HDPE. Similar to PET, strong export markets mean higher bale prices – even if the material is contaminated. Thus, there is no incentive for California recyclers to provide cleaner bales.

* * * * *

There is an expectation that beverage container recycled material market conditions, as described in this report, will change over time. However, changes to the grant program over the last four months were not entirely expected, and as we write this report, the grant programs' funding status for fiscal year 2009/2010 remains fluid. On June 23, 2009, the DOR announced 85 percent proportional reductions to most Section 14581 programs. As a result, funding for the grant program was reduced from $20 million to $3 million. However, the State Legislature is considering alternative cost-cutting measures, and program stakeholders have their own proposals for DOR budget-savings. Thus, it is likely that the current $3 million in grant funding will either increase or decrease, before grant funds can even be allocated.

At this point in time, the grant program is funded, albeit at a diminished level. Thus, the DOR may utilize the analysis and recommendations in this report to help prioritize funding projects for the remaining $3 million in grant funding, or for whatever amount of grant funding is available. Going forward, this market analysis may also help provide insight that will assist the DOR in efficiently and effectively allocating their scarce programmatic resources.

[2] Including evaluating new resin codes for bioplastics.

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Section 1

Introduction

1. Introduction

This report is the third (3rd) market analysis that NewPoint Group has prepared for the California Department of Conservation (DOC), Division of Recycling (DOR). The first report, *Market Analysis for Recycled Beverage Container Materials*, completed in February 2005, provided a detailed and comprehensive assessment of recycled beverage container material markets; collection and processing; end-uses by material type; market issues; and recommendations. This first report also included (1) descriptions of processing and reclaiming technologies and procedures for each of the major material types, and (2) descriptions of major end-use categories. We do not duplicate these descriptions in this 2009 Market Analysis Update.

The second report, *Market Analysis for Recycled Beverage Container Materials: 2007 Update*, completed in May 2007, provided a description of current market status and dynamics for each beverage container material type. This second report also identified California market players; presented current and future market capacity information; discussed new end-uses and processes; and addressed market issues and barriers.

Many market conditions have changed in the only two years since 2007. The nature of recycled material markets is inherently dynamic. As we have stated in each of the market analyses we have produced for the DOR: "… recycled beverage container materials are dynamic. What may be true as these words were written may no longer be as relevant when they are read months, or years, later."

This caveat is particularly relevant today. In fact, it would be more accurate to say that over just the last year, recycled materials markets have been volatile, rather than dynamic. Certainly, this market volatility must be considered within the context of the current economic climate, which, to understate, is almost unprecedented.

Scrap prices for most recycled materials achieved historic highs in the summer of 2008. By November of 2008, recycled material prices had plummeted, markets evaporated, and some established recyclers were considering bankruptcy.

Given the current volatility of recycled material markets, this 2009 market analysis takes a slightly different approach than the 2007 Update. In addition to assessing current market dynamics, material flows, and capacity; we now identify and discuss the role of various market influences more generally. Understanding how different factors affect recycling markets allows readers to better understand how market conditions could change in the months ahead, as they inevitably will.

This introductory section describes the organization of the report and DOC's Recycling Market Development and Expansion Grant Program (grant program), including areas of interest, previous grant projects, and the potential future of the grant program.

A. Organization of the Report

Following this introduction section, the report includes separate sections on aluminum, glass, PET, and HDPE; and a single section on plastics #3 to #7 and bi-metal. Each of these sections includes the following:

A. Material Flows and Market Players: Material flows, including recycling, processing, and end-use. We discuss quantities of materials, current market capacities, expected future market capacities, and major market players

B. Current Market Dynamics: current market dynamics and how these dynamics influence recycled material markets

C. Market Influences: other factors that influence recycled material markets

D. New Market Alternatives and Opportunities: identification of new alternatives and opportunities in collection, processing, and end-use; and recommendations to improve market conditions through market development grants and related DOR programs.

The final section, Factors and Trends Affecting Recycling, includes:

A. General Factors Influencing Recycled Material Markets: a discussion of the broader factors that affect recycled material markets, considering issues such as oil prices, global warming, and the economy

B. Trends in Beverage Markets and Beverage Containers: a discussion of beverage market and beverage container trends that affect recyclability and the materials that are available to be recycled.

Appendix A to this report provides literature references and a list of those interviewed for this report.

The original objective of this report was to provide the DOR, and potential grant applicants, with updated information on recycled beverage container material markets. The report was also intended to assist the DOR as they reviewed and evaluated grant applications.

Unfortunately, during the time period in which we were writing this report, the economic downturn affected not just recycled material markets, but also the ability of the DOR to conduct the grant program. In April 2009, in response to the State's severe budget crisis, the DOR suspended payments on all in-process grants, as well as suspending a number of other DOR programs.

Budget conditions have further declined since April, and in June 2009, the DOR was, for the first time, facing a negative fund balance. The negative balance is a result of borrowing from the recycling program to support general fund activities, decreasing container sales, and increasing recycling rates. With limited unredeemed funds available to support the recycling program, in June 2009, the DOR was considering proposals to severely reduce or eliminate many of the funded programs defined in Section 14581 of the Beverage Container Recycling and Litter Reduction Act.[1]

In writing this report, we were focusing on the market conditions for each material, and the implications of those conditions on the grant program. As we finalized this report, funding for the grant program was, at best, significantly reduced. Thus, this third market analysis reflects a blending of information and analyses that meet the original intent of the report, combined with

[1] Section 14581 of the Act states that subject to availability of funds, the DOC shall expend moneys set aside in the fund for: handling fees, Community Conservation Corps (CCC), CCC grants, payments to cities and counties, grants for recycling and litter reduction, processing payments, public education, quality incentive payments (QIPs), market development and expansion grants, loan guarantees, market development payments (MDPs), recycling incentive payments, grants for recycling at parks and multi-family housing, and collection-focused grants.

discussions that reflect the realities of the situation that the DOR faced, as of June 2009.

In each of the material-specific chapters, the New Market Alternatives and Opportunities sections identify projects and policies that we believe address current market issues. While these recommended projects and policies are reasonable suggestions from a program needs-based perspective, they may no longer be realistic suggestions from a Department budgetary perspective.

Given the grant programs' reduced, and uncertain, funding, many of our recommendations represent more of a "wish-list", than a practical list of alternatives to consider. Rather than remove these portions of the report, we chose to leave the new market alternatives and opportunities portions of the report intact. However, the reader should keep in mind that for the most part, the DOR is not in the position to implement many of these recommendations at this time.

* * * * *

The information and analyses in this report reflect a synthesis of often diverse perspectives from over thirty (30) industry experts, and our own extensive review of the literature. NewPoint Group thanks the many individuals in the recycling industry that we interviewed in preparing this report. We could not have prepared this report without the real-time market information that these individuals so generously provided.

B. The Beverage Container Recycling Market Development and Expansion Grant Program

The California Department of Conservation conducts a variety of programs vital to California's public safety, environment, and economy. The mission of the DOC is to balance today's needs with tomorrow's challenges and foster intelligent, sustainable, and efficient use of California's energy, land, and mineral resources. Sustainable use, as defined by the DOC, refers to an attempt to provide the best outcomes for the human and natural environments, both now and into the indefinite future. The DOC manages several programs under the following organization units:

- Division of Recycling
- Division of Land Resource Protection
- Office of Mine Reclamation
- California Geological Survey
- Division of Oil, Gas, and Geothermal Resources
- State Mining and Geology Board.

An important goal of the Beverage Container Recycling Program within the Division of Recycling, is encouraging development of products made from recycled beverage containers, thereby creating and maintaining a profitable beverage container recycling market for those materials recycled under the program. The State recognizes that it is not simply enough to create incentives to recycle containers, and that it is equally important to help ensure that there are viable end-uses for those containers that are recycled. This is accomplished through a variety of programs within the Division of Recycling.

The Beverage Container Recycling Market Development and Expansion Grant Program, now managed by the Program Innovation Branch, within the DOR, was initiated in 2003. The grant program initially provided up to $10 million in grant funding per year, for a period of four years. AB 3056, signed into law in September 2006, increased and extended the grant program. The program now provides up to $20 million annually in grants, through January 1, 2012. The DOR has awarded two grant cycles since AB 3056 was signed into law.

Pursuant to Section 14581 (a)(11) of the Beverage Container Recycling and Litter Reduction Act, grants may be awarded for recycling market development and expansion-related activities aimed at increasing the recycling of beverage containers, including, but not limited to, the following activities:

1. Research and development of collecting, sorting, processing, cleaning, or otherwise upgrading the market value of recycled beverage containers
2. Identification, development, and expansion of markets for recycled beverage containers
3. Research and development for products manufactured using recycled beverage containers
4. Research and development to provide high-quality materials that are substantially free of contamination
5. Payments to California manufacturers who recycle beverage containers that are marked by resin type identification codes "3," "4," "5," "6," or "7," pursuant to Section 18015.

The DOC has also been interested in job creation associated with grant projects, particularly jobs for youths and/or graduates of the California Conservation Corps or Local Conservation Corps.

Over the last several years, the DOC has developed a more holistic and systemic approach to recycling and environmental awareness in general. The DOC has incorporated sustainability concepts into their program, defining product stewardship and recycling sustainability as follows:

> Product stewardship is a product-centered approach to environmental protection. It calls on those in the product lifecycle, manufacturers, retailers, users, and disposers to share responsibility for reducing the environmental impacts of products. An example may be a retailer taking responsibility to ensure containers are collected and processed to become high quality feedstock for the manufacture of new containers.
>
> Recycling sustainability is an attempt to provide the best outcomes for the human and natural environments, both now and into the indefinite future. Common elements included are: minimal consumption of natural resources; reuse or recycling of natural resources; reuse or recycling all waste; no polluting or emitting of waste beyond what ecosystems can break down and harmlessly recycle; and reliance on clean, renewable energy.

Over the course of the grant program, the focus has evolved somewhat from collection and processing improvements to manufacturing (including upcycling and recycled content products) and research and development (R&D). The DOC's intent is to continue to move in the direction of more innovative and far-reaching projects that address broader recycling and packaging sustainability issues. Thus, the DOC encourages grant projects that address broader goals of recycling and packaging sustainability.

There are many ways to reduce the environmental impact of beverage containers. Some approaches are more relevant for one material type than another, and some approaches have already been implemented to their current technological level – for example, the recycled content level of aluminum cans (40 to 50 percent post-consumer) is about at its maximum, given various aluminum alloy characteristics and limitations.

Table 1-1, on the next page, identifies eleven (11) potential mechanisms to reduce the environmental impact and/or improve the sustainability of beverage containers. This is not an all-inclusive list, but rather was intended to present a variety of alternative approaches to achieving the DOC's goal of sustainable containers and packaging systems. Note that these steps can be implemented by different players in the economic value chain – from consumers, to the original container manufacturers to re-manufacturing end-users. Many of the 76 projects funded by the grant program to date fall within one, or more, of these

Table 1-1
Potential Approaches to Improving the Sustainability of Beverage Containers

Approach	Key Player(s)
1. Increase recycled content in containers	Container manufacturers, beverage manufacturers
2. Reduce impact of container production (reduced emissions, reduced energy use, reduced chemical use)	Container manufacturers
3. Reduce material in containers (light-weighting)	Container manufacturers, beverage manufacturers
4. Design for recycling	Container manufacturers, beverage manufacturers
5. Increase use of renewable resources/ decrease use of non-renewable resources	All
6. Increase use of recycled material in non-container products and packaging	Container manufacturers, beverage manufacturers, other packaging manufacturers
7. Increase quality of recycled material	Consumers, recyclers, processors
8. Improve efficiency of collection, processing, remanufacturing	All
9. Reduce transportation related to production, recycling, processing, and remanufacturing	All
10. Reduce water use or increase water recycling in manufacturing, processing, or remanufacturing	All
11. Increase recycling rates	All

eleven general approaches to improving the sustainability of beverage containers.

Table 1-2, on the next page, summarizes the completed and active grants from the first six (6) years of the grant program (2003/04 to 2008/09. These statistics do not include four grants directed toward PET, and one grant directed toward mixed plastic, that were never implemented. Approximately one third of the total number of grants has been awarded for projects related to glass, one third to multi-material projects (primarily for material recovery facility (MRF) improvements), and almost one third to plastic grants (all plastics, PET, and/or HDPE). There have only been three grants directed toward aluminum.

The distribution of dollars is somewhat different. Approximately 25 percent of the total active or completed dollars awarded have been for glass projects, 25 percent for multi-material projects, and over 45 percent for plastic grants. Just over $1 million has been awarded for aluminum projects. The high level of funding for plastic reflects that when the grant program was initiated there was no existing infrastructure for PET reclaiming in California. The high level of plastic investment also reflects advancements in plastic processing equipment, and increased use of recycled plastic in sheet and other products.

Much of the funding for glass and multi-materials, and even the few aluminum grants, are related, in large part, to the extensive additional processing needs resulting from single stream curbside programs. Table 1-2 also provides the average dollars per grant, by material type. The three categories of plastic grants have the highest average amount per grant, from just below $1 million to $1.6 million. Glass and multi-material grants each average approximately $700,000, while the aluminum grants averaged the lowest, at $333,333.

Table 1-3, on the next page, summarizes the number of completed and active grants by type of project. Over one-half of the number of grants, and

Table 1-2
Summary of Grant Program Completed and Active Grants by Material Type (2003/04 to 2008/09)

Material	Number of Grants	Percent of Grants	Grant Dollars	Percent of Grant Dollars	Average per Grant Award
Aluminum	3	4%	$1 million	**1%**	$333,333
Glass	25	33%	18 million	**27%**	720,000
Plastic	6	8%	9 million	**13%**	1.5 million
PET	15	20%	21 million	**31%**	1.4 million
HDPE	2	3%	2 million	**3%**	1.0 million
Multi-material	25	32%	17 million	**25%**	680,000
Total	**76**	100%	**$68 million**	100%	**$894,737**

Table 1-3
Summary of Grant Program Completed and Active Grants by Grant Type (2003/04 to 2008/09)

Grant Type	Number of Grants	Percent of Grants	Grant Dollars	Percent of Grant Dollars	Average per Grant Award
Collection and processing	44	58%	$43 million	**63%**	$977,273
Manufacturing	13	17%	17 million	**25%**	1.3 million
Research and development	19	25%	8 million	**12%**	421,053
Total	**76**	100%	**$68 million**	100%	**$894,737**

almost two-thirds of the grant dollars, have been awarded for collection and processing projects. Only 17 percent of the grants, and 25 percent of the dollars, have been for manufacturing projects. One-quarter of the grants, and only 12 percent of the dollars, have been for research and development projects. The average grant award per category shows that manufacturing grants are the highest, at an average of $1.3 million per grant. Collection and processing grants average just under $1 million per grant, although there was a wide range in the amounts for collection and processing grants, with many close to $100,000, and many multi-million dollar awards. Research and development average grant size is lower, at $421,053 per grant.

Table 1-3 illustrates that, while the DOC has sought to focus more grant effort on broader recycling and packaging sustainability issues, much of the grant moneys have been directed at traditional processing activities. One reason for the emphasis on collection and processing grants in the first few years of the program was that there were significant processing infrastructure needs in the State. As many of these processing needs have now been addressed, the State was seeking to shift the grant focus to manufacturing and research and development.

The grant program has already awarded $68 million in funds for market development and expansion programs. Many of these projects have resulted in significant improvements in recycled material markets, particularly as they relate to cleaning single stream curbside glass, alternative glass markets, PET reclaiming, and HDPE reclaiming. Tangible benefits to California's recycling infrastructure have been realized through the grant program.

Section 2

Aluminum

2. Aluminum

Aluminum beverage containers are maintaining their role as the most recyclable, and recycled, beverage container type in the Beverage Container Recycling Program. In 2007, the price of recycled aluminum was reaching near historic highs. The key market issue at the time was the decline in recycling rates. Both of these market conditions are now at opposite sides of the spectrum. In 2009, recycled aluminum prices are reaching near historic lows. However, on a positive note, aluminum CRV recycling in California for 2008 increased to 84 percent, the highest aluminum recycling rate in over ten years.

A. Material Flows and Market Players

The vast majority of all beverage containers recycled in the United States are aluminum. Aluminum beverage containers, often called UBCs (used beverage containers) have maintained a recycling rate of just below 55 percent nationally. Within California, the aluminum beverage container recycling rates has been as high as 85 percent in the early 1990s, and as low as 69 percent in 2003. In 2008, the aluminum recycling rate in California was 84 percent, reflecting over 8 billion containers recycled. The aluminum CRV recycling rate has not been as high as 84 percent since 1995. **Figure 2-1,** on the next page, illustrates aluminum beverage container sales, recycling, and recycling rates since 1990.

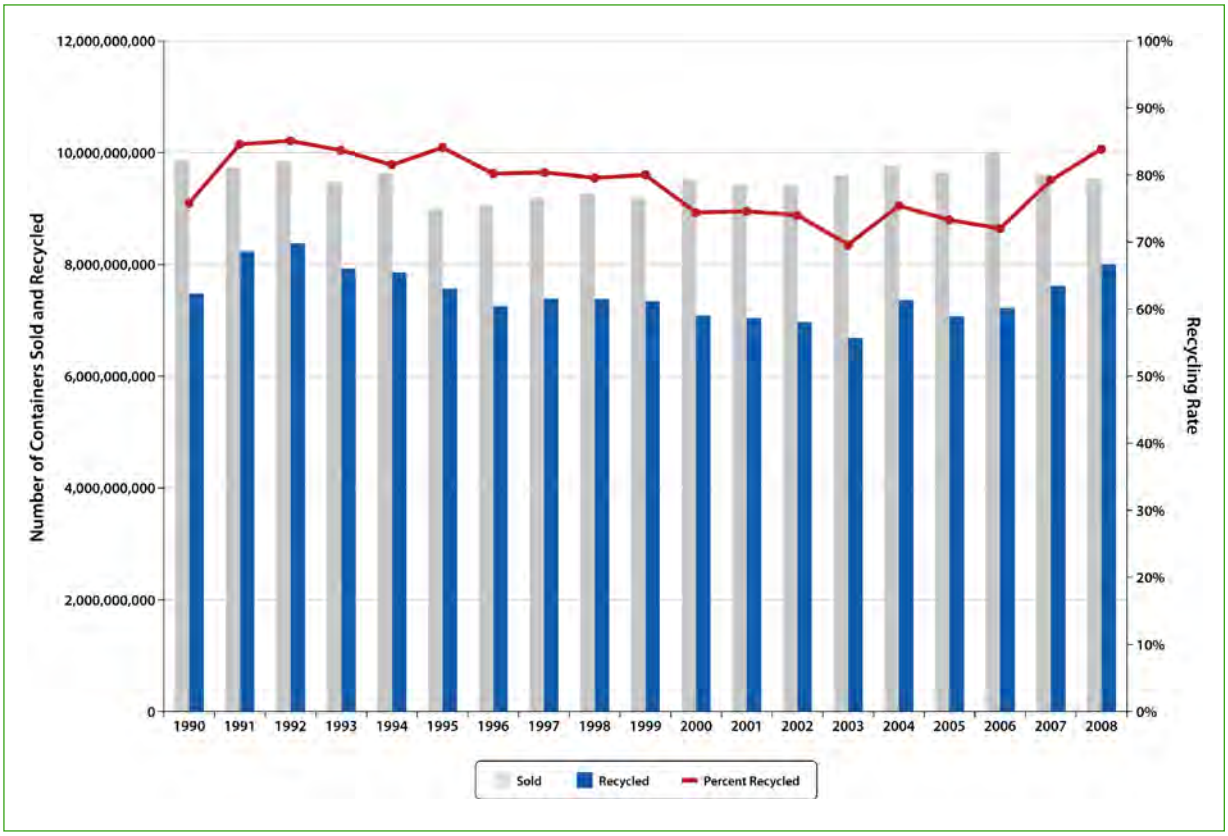
Most aluminum cans in California are recycled through buyback recycling centers. Only four percent of aluminum cans are returned through curbside programs. In addition, the vast majority, over 99 percent, of recycled aluminum is CRV material. As a result, aluminum is generally of higher quality than other beverage container materials.

The relatively new aluminum containers in the beverage market can be recycled with traditional aluminum cans. Aluminum bottles, which are heavier than aluminum cans, are actually made of a higher-grade aluminum alloy than regular aluminum cans, and are a preferred feedstock for aluminum smelters. However, there are very few of these cans in the market, or recycling stream.

Figure 2-2, on page 2-3, illustrates the flow of recycled aluminum, from recycler to can manufacturer. The Can Manufacturer's Institute states that a recycled aluminum can will make its way back into a new aluminum can in as few as 60 days. The top ten processors, identified in alphabetical order, handle 69 percent of all the aluminum recycled in California. The remaining 31 percent is handled by over 70 other certified recyclers. Processors generally sell baled aluminum to smelters located in the Southeastern United States. From California, it costs from $2,000 to $2,400 per load (5 to 6 cents per pound) to transport aluminum material to the smelters.

The three major smelters of UBCs in the United States are Novelis (formerly Alcan), Alcoa, and Wise Alloys. In addition, Arco Aluminum conducts smelting, but typically does

Figure 2-1
Aluminum Beverage Containers Sold and Recycled (1990 to 2008)



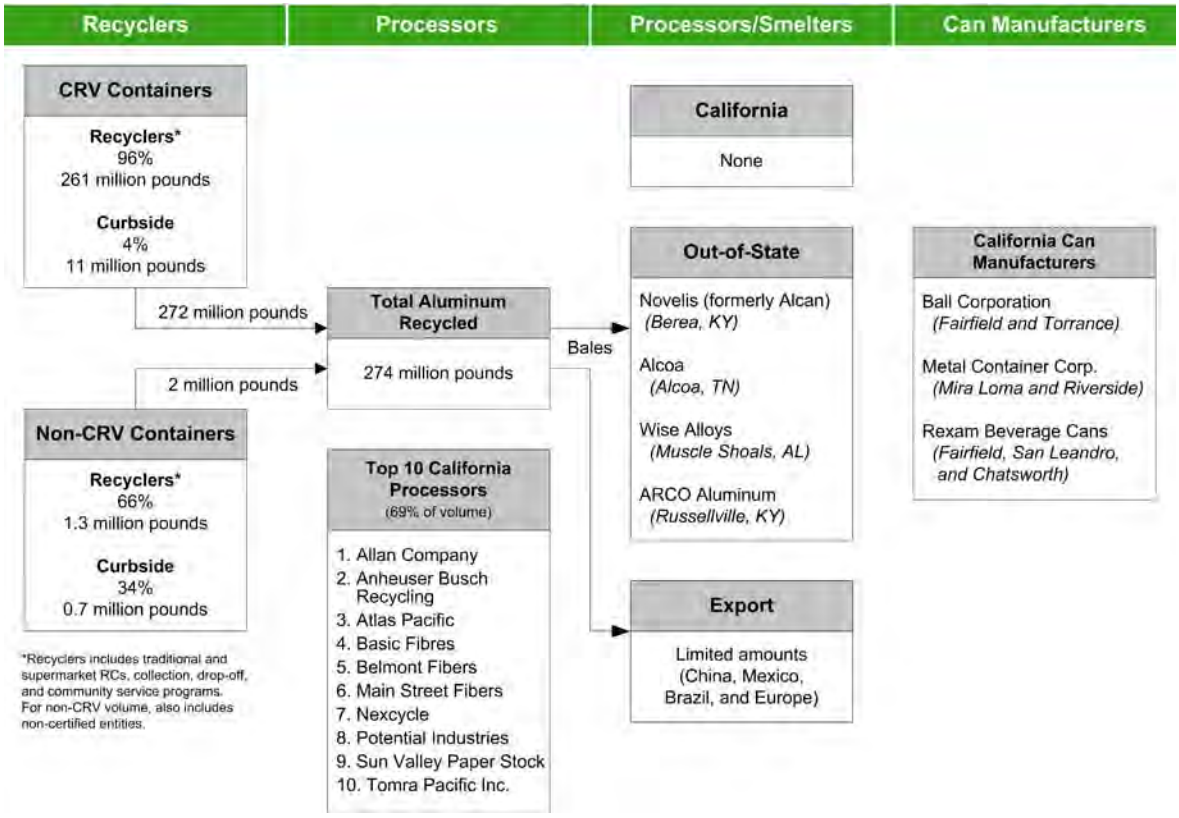
not buy directly from processors. A fifth smelter, Aleris International, filed for bankruptcy in early 2008, and is restructuring the company. Aleris' business was focused primarily on non-UBC sources of recycled aluminum, however some California processors do ship to Aleris. The majority of California aluminum is shipped to Novelis and Alcoa, who are the strongest customers. Several California processors expressed concern that there are relatively few outlets for aluminum bales in the United States.

Aluminum smelters produce rolls of can sheet or can stock. Can sheet typically contains between 40 and 50 percent UBC recycled content, and between 50 and 65 percent total recycled content, including scrap from can manufacturers.[1] The can sheet is shipped around the country to can manufacturing locations. These can manufacturers are typically located close to beverage manufacturers and bottling facilities, in order to minimize the cost of shipping empty cans to filling sites. As shown in Figure 2-2, there are three major aluminum can manufacturers, with seven facilities, located in California.

In January 2008, Alcoa announced a goal to increase the recycling rate of aluminum cans in the United States from the current level of just over 50 percent, to 75 percent by 2015. Greg Wittbecker, Alcoa's Director of Corporate Metal Recycling Strategy noted that, "the aluminum industry must work together for common sustainability goals that transcend individual commercial objectives, and we must approach this with a sense of urgency. It's all about recapturing the pool of energy before it is lost to the landfill" (Alcoa.com, January 22, 2008).

[1] Can manufacturers bale all of the scrap cuttings from the can-making process and ship these back to smelters to incorporate into new can sheet stock.

Figure 2-2
Aluminum Recycling and End Uses in California (2008)



The Aluminum Association, an international industry trade group, followed in November 2008 with an announcement of an industry-wide effort to reach a 75 percent recycling goal by 2015. While this rate would be a significant increase as compared to current national levels, 75 percent is a reasonable goal. Aluminum recycling rates in the United States have been as high as 68 percent (in 1992), and recycling rates in Brazil and Japan are 95 percent, and 92 percent, respectively. The Association is considering deposit legislation and an addition to other efforts, in order to reach the national target.

There is adequate current and future aluminum smelting capacity to handle California's recycled aluminum cans. **Table 2-1,** on the next page, compares current and potential future aluminum recycling in the United States and California. Currently, aluminum smelters in the United States recycle approximately 900,000 tons of UBCs a year. If the U.S. achieved a 75 percent national UBC recycling rate, total aluminum recycled would increase by 42 percent, to approximately 1.29 million tons.

California's aluminum recycling rate is already 84 percent, accounting for over 15 percent of the national total. If California was able to increase to a 90 percent recycling rate for aluminum cans, California cans would still only represent 11.4 percent of the aluminum cans recycled in the United States, assuming a national 75 percent recycling rate.

Table 2-1
Comparison of United States and California Current and Potential Future Recycled Aluminum

Category	United States	California
1. Current aluminum recycling	900,000 tons	137,000 tons
2. California 2008 percent of national		15.2%
3. 2015 target (or potential) recycling rate	75%	90%
4. 2015 estimated aluminum recycling	1.29 million tons	149,000 tons
5. California 2015 percent of national		11.4%
6. 2015 percent increase over current	42%	12%
7. 2015 increase in recycling over current	390,000 tons	12,000 tons

Table 2-1 demonstrates that in theory, the current smelting capacity in the United States should be able to handle any increases in California aluminum beverage container recycling. There are periods of time, particularly in lower demand periods, such as summer, when California processors have difficulty selling loads of aluminum. During periods of reduced demand, smelters may take fewer orders for cans, or push orders out further into the future, so that processors may have to wait to sell the material. Processors may also choose to hold on to their aluminum to wait out periods of low prices.

Reductions in can stock production due to the slow economy could lead to a further reduced demand for UBCs that is likely to be exacerbated by the normal summer slow-down in can production. Smelters can be more selective in who they buy from, and reject loads that are not of the highest quality. Over the two previous summers, even California loads of aluminum, which tend to be of higher quality than aluminum from many other parts of the country, have been rejected, due to contamination.

In late 2007, Alcoa announced a $22 million capacity expansion to their Tennessee smelting facility. This expansion, scheduled to come on-line in 2010, would almost double the company's capacity for recycled aluminum. The expansion includes state-of-the-art environmental and fuel efficiency technologies. This expansion could absorb significantly more recycled aluminum cans.

Unlike plastics, export has been a minor component of recycled aluminum beverage can markets. Export generally is reserved for lower quality aluminum that generates even lower prices.

Nationally, in 2007, less than one percent of recycled UBCs were exported. In 2008, UBC exports doubled, but were still only approximately two percent of total UBCs recycled. UBC exports in January 2009, were 45 percent higher than in January 2008. However, extrapolating January exports to the entire year would still yield estimated exports at only two percent of UBCs recycled in 2009.

UBC export markets include Brazil, Mexico, and China. Exports to China (or Hong Kong[2]) may increase in the future, as China begins to produce more aluminum cans.

Anecdotally, processors say that export may be increasing in 2009, due to low aluminum pricing, and the elimination of import duties in China. However, the larger California processors focus on domestic end markets, not export.

[2] China prohibits the importation of whole, used, beverage containers. Reportedly, it is common practice that used beverage containers are first exported to Hong Kong, and then shredded and sent to China, or simply smuggled into China without further processing.

B. Current Market Dynamics

Market dynamics, particularly for aluminum, are primarily driven by prices. Unlike plastics, aluminum pricing generally does not dictate end uses. However, aluminum pricing does dictate profitability of recycling centers. Because aluminum is the only beverage container material that is truly economic to recycle, many recycling centers depend on the profitability of aluminum recycling. When aluminum UBC prices are low, recycler profitability decreases. When aluminum UBC prices are high, recycler profitability increases.

Figure 2-3, on the next page, provides the average scrap values for aluminum, from the American Metal Market. The Division of Recycling utilizes these annual averages, for the October through September time period, to determine the need for processing fees and payments. The American Metal Market prices are higher than prices paid to recyclers.

Aluminum UBC scrap values are based on global aluminum markets. The London Metal Exchange (LME) sets the price of aluminum based on global supply, demand, and inventories. Reductions in aluminum demand are linked to reductions in major purchase items like automobiles and housing. The top three end-uses for aluminum are transportation, packaging, and building and construction. When demand for durable goods first started declining in 2008, aluminum prices were held high by high energy costs and reduced aluminum supply. However, as energy costs declined, and aluminum inventories increased, aluminum prices declined. In early 2009, industry analysts predicted that the LME price for primary aluminum would increase to between 90 cents and $1 per pound in 2009. As of May 2009, the LME price is still significantly lower, at 67 cents per pound.

Aluminum UBC prices are based on a percent of the LME price for primary aluminum. The percentage varies by season, so that when UBC demand is generally higher – in the winter months when summer cans are produced – the discount percentage is lower (typically 25 percent). In the summer months, when fewer new cans are being produced, the LME discount percentage is higher (35 percent).

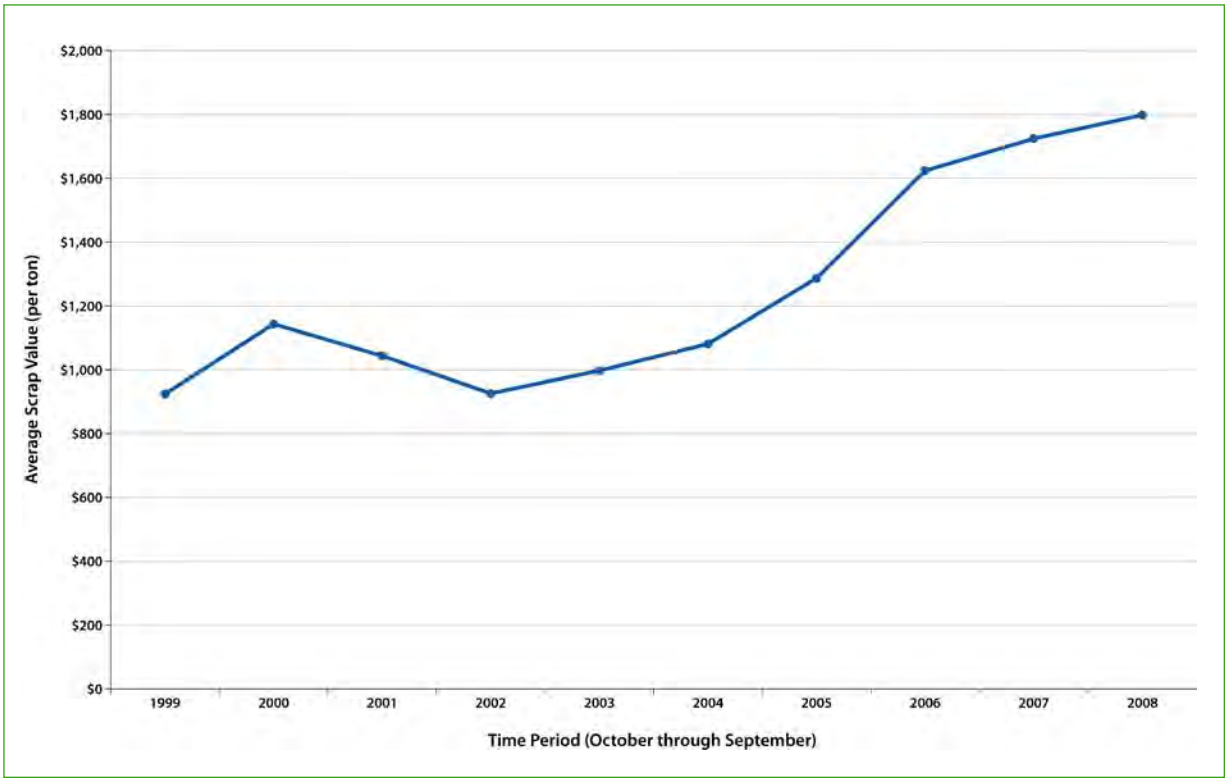
Through much of 2008, LME prices for primary aluminum were near historic highs. The high demand was primarily due to strong demand from China for raw materials, including aluminum. In the summer of 2008, Blair Stewart of JW Aluminum in South Carolina noted, "commodities in general have been in short supply, and people attribute that to China for the most part. They've had strong expansion. They're sucking up all the commodities in the world, aluminum being one of them. They've created a supercycle and driven the price of commodities to astronomical heights" (Scrap. July/August 2008, p.91).

Even as global aluminum demand and prices for UBCs were high, it was not always easy to find purchasers for California UBCs. The peak aluminum prices occurred during the summer of 2008, when aluminum UBC demand was at its seasonal low point. In addition, the high UBC price meant that more aluminum was available to smelters for purchase from other parts of the country.

Like other commodities, aluminum is suffering significant drops in demand and price with the global economic downturn. Aluminum UBC pricing, however, did not drop as suddenly as many other materials. **Figure 2-4,** on the next page, demonstrates the fluctuation in monthly aluminum prices between February 2008, and February 2009. **Figure 2-5,** on page 2-8, presents average weekly regional (California and Nevada) prices for sorted and baled aluminum cans, delivered, since early 2005, from *Waste and Recycling News*. Both figures illustrate dramatic changes in aluminum pricing.

The lowest aluminum prices occurred in January and February 2009. National average delivered,

Figure 2-3
Aluminum UBC Average Scrap Values (1999 to 2008)



Source: *California Department of Conservation*

baled aluminum prices are typically about four cents per pound higher than California, with the difference reflecting increased transportation costs from the West Coast.

Aluminum UBC pricing has not recovered as rapidly as recycled plastic prices. In late April 2009 and early May 2009, average regional UBC prices were 41 cents per pound – only 1.5 cents per pound above the low from January. In the current economic climate, even experienced industry analysts are hesitant to predict future aluminum pricing.

C. Market Influences

The vast majority of aluminum UBCs will be collected and recycled into new aluminum cans. This will not change, unless there is significant market disruption. As with any commodity, there will be up and down cycles. **Figure 2-6,** on page 2-8, provides a schematic of six primary factors that influence the price of recycled aluminum.

Because of energy savings resulting from using UBCs in place of primary aluminum, there are strong economic incentives to utilize UBCs in can stock. The amount of UBCs that can be used in can stock is limited by the availability of materials, and the balance of aluminum alloys in the can stock and lid stock. Aluminum can lids are made of a different alloy than the can body, and thus there must be some primary aluminum put into can stock to balance lid alloy that is present in UBCs.

While recycling UBCs back into can stock creates a tight closed-loop cycle, this supply component of the aluminum cycle has relatively

Figure 2-4
Aluminum UBC Average Scrap Values by Month (February 2008 to February 2009)

Source: *California Department of Conservation*

no influence on aluminum pricing and relatively little influence on demand.

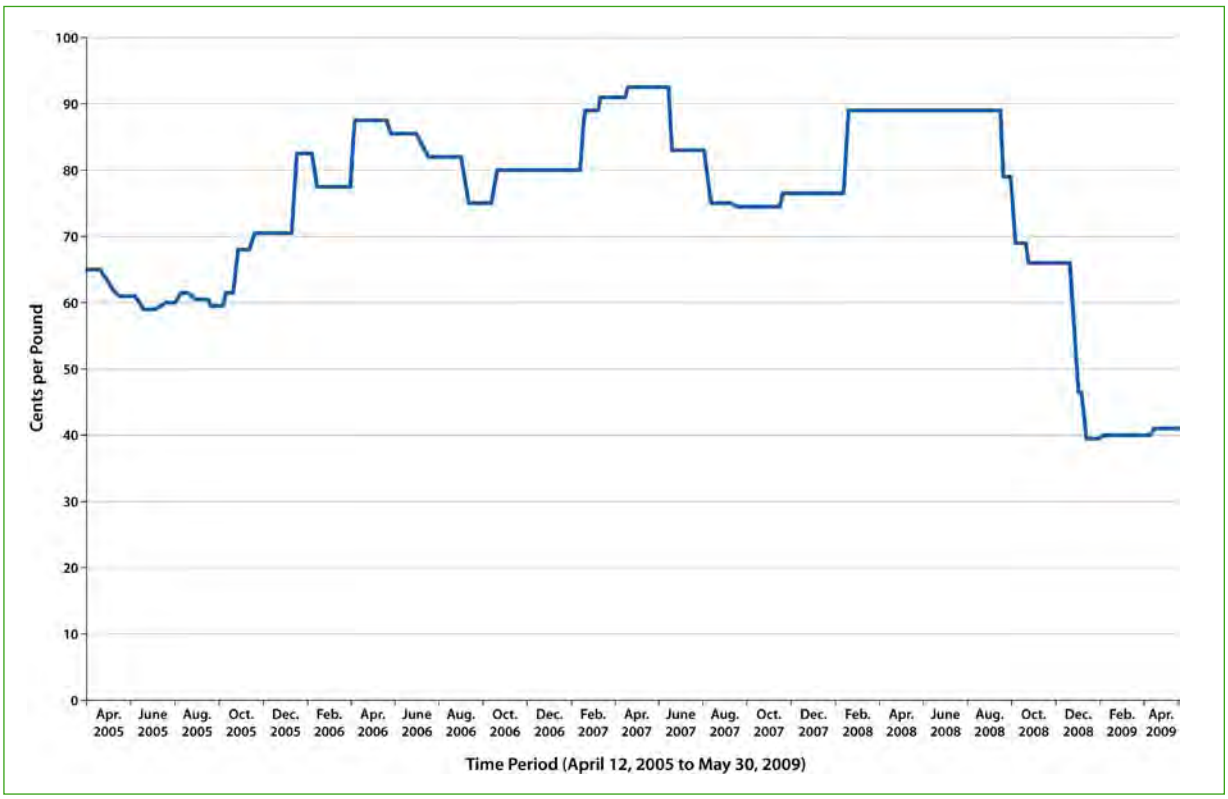
Demand for aluminum is driven by global markets for durable goods sectors such as construction and transportation. These industrial sectors are driven by the global economy, with significant influence from China. When aluminum demand is low, stocks are high, and primary prices are low; UBC prices will also be low. This is the situation in spring 2009, and will likely continue until the global economy begins to grow again.

The availability and price of energy is also a critical component in the aluminum cost equation, as producing primary aluminum is energy intensive. In some cases, even when aluminum demand is low, and stocks are high, primary prices will be high – due to high energy costs. This dynamic occurred in the summer of 2008. The economy was showing signs of weakness, but high energy costs helped keep aluminum costs high.

When aluminum demand is high, and supplies and stocks are low, then primary prices will be high. This dynamic occurred the few years leading up to the summer of 2008 – when strong demand, particularly from China – kept primary and recycled aluminum prices at high levels.

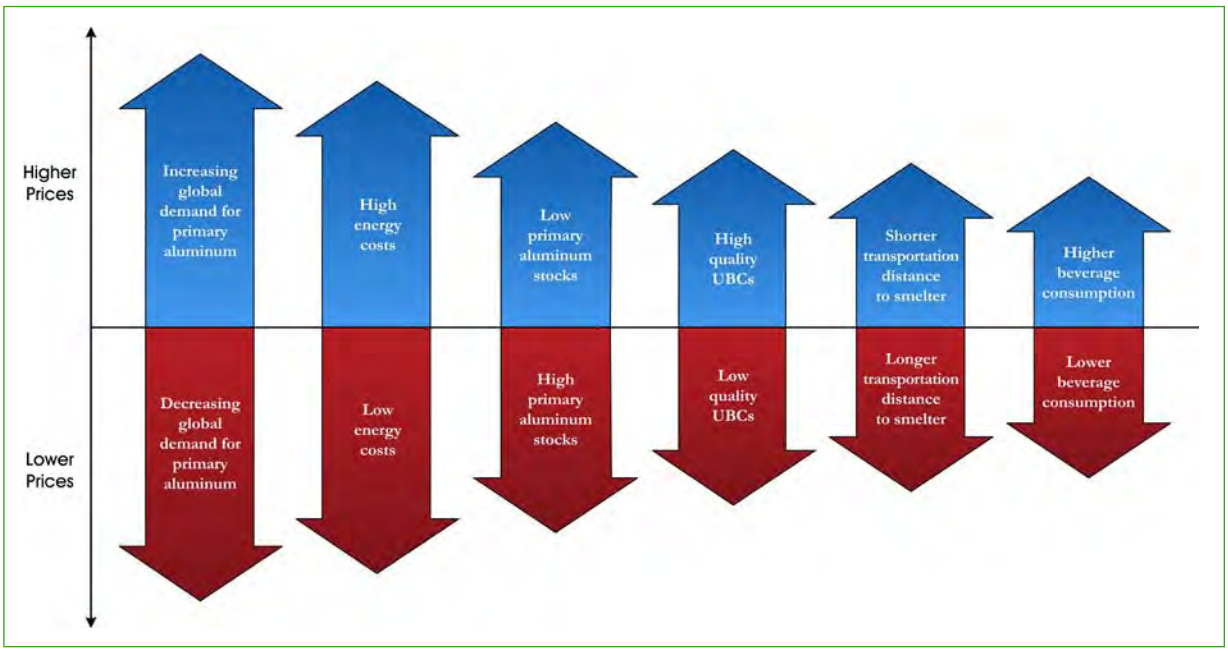
High or low aluminum UBC prices do not seem to strongly affect aluminum recycling rates. In California, this is due in large part to the fact that there is an additional five cents per container CRV. When CRV rates increased in 2007, some recyclers saw increased levels of contamination in the cans, as some customers tried to increase their payments. This practice increased the amount of contamination

Figure 2-5
California and Nevada Weekly Prices for Aluminum Cans, Sorted, Baled, and Delivered, in Cents per Pound (April 2005 to May 2009)



Source: *Waste & Recycling News, Commodity Pricing Service.*

Figure 2-6
Factors Influencing Recycled Aluminum Bale Prices



in loads, and in some cases resulted in smelters rejecting loads. Rejected loads must be shipped to secondary smelters, or exported – both options resulting in prices that are 10 to 15 cents per pound lower than higher quality loads.

Southern California recyclers observe that when aluminum prices are low, more out-of-state cans come into California. This illegal activity increases when cans are worth less (i.e., low scrap value). Some individuals in states that do not have deposit systems seek to maximize their income by bringing aluminum cans into California, where they can receive CRV payments.

D. New Market Alternatives and Opportunities

Because use of recycled aluminum in cans is the highest and best use, there is no need for new end-use market alternatives for recycled aluminum. While aluminum beverage container recycling is extremely successful, there are opportunities to improve aluminum recycling and markets in three areas: recycling, processing, and end-use. Some of these opportunities fit within the scope of the Market Development and Expansion Grants, while others do not.

1. Increase the Quantity of Aluminum Recycled

Aluminum recycling rates have been increasing, but they are still not at the level of the early and mid-1990s, or at levels seen in other countries such as Brazil and Japan. Even at aluminum's current low market value, there is significant economic and resource loss when cans are thrown away. Martha Finn Brooks, former President and COO of Novelis, said, "More than 50 billion cans disappear into landfills every year in the U.S. alone, not only is this a missed opportunity to help our environment, it represents a tremendous amount of economic value being buried in the ground. As individuals, we can all do our part by making sure we toss our empties into the recycle bin, not the garbage can" (http://novelis.com, April 21, 2008). The aluminum industry's recently established goal of a 75 percent recycling rate recognizes the value of aluminum recycling.

Even at the low scrap values of May 2009, the 1.9 billion aluminum cans not recycled in California in 2008 represent over $98 million in lost CRV and scrap values. The lost CRV, at least, is utilized to support recycling in the State, the scrap value is simply gone forever. Efforts to increase the collection of aluminum cans, although not part of the Market Development and Expansion Grant Program, would benefit aluminum. There may be opportunities to increase aluminum recycling through collection at special events, increased and improved education, recycler incentives, mining of landfills, and aluminum can collection at gas stations or other public locations. The poor economy may also result in increased aluminum recycling, as it becomes more worthwhile to obtain that 5 or 10 cent CRV.

2. Improve the Quality of Recycled Aluminum

The three Market Development and Expansion Grants that have been awarded to aluminum-related projects are for efforts to improve the quality of aluminum, either from curbsides or recycling centers. Aluminum from curbsides is cleaner than other materials from curbside programs, and generally, the eddy current system used to remove aluminum on MRF sorting lines is fairly effective at minimizing contaminants. However, Anheuser-Busch Recycling Corporation received a grant, yet to be implemented, to construct a cleaning/ processing

facility for aluminum from single stream curbside programs. The system will remove paper, plastic, glass, and other contaminants that make up almost nine percent of typical aluminum loads from curbside programs.

At buyback centers, customers may intentionally put lead and other contaminants inside cans to increase their CRV and scrap payments. This became a problem for TOMRA Pacific in 2007, when the CRV increased to 5 and 10 cents per container. TOMRA had aluminum loads rejected by a smelter because of lead contamination.

TOMRA received a grant to add additional aluminum cleaning and processing capacity to remove non-aluminum contaminants. The additional cleaning allows TOMRA to obtain a better price for their aluminum. However, because the cans are cleaned after CRV payments have been determined, the company actually loses some CRV that is paid out to customers, but not claimed from the DOR. If contamination of aluminum cans continues to be a problem, there may be opportunities within the grant program to fund additional aluminum processing at other facilities in the State.

3. Improve the Sustainability of Aluminum Can Manufacturing

There is no need for new alternatives for recycled aluminum beverage cans. The use of UBCs to produce can stock is a sustainable solution for UBCs. Alcoa is currently expanding capacity to melt UBCs and reduce the environmental and energy costs of can stock production. Other aluminum smelters may also need to consider expansions and upgrades to handle the additional aluminum the industry is targeting to recycle. While there is potential to expand aluminum smelting capacity, all of the country's secondary aluminum smelting facilities are located in the Southeast or East Coast, well beyond the scope of the grant program.

Aluminum beverage cans are produced at seven locations in California. In many regards, aluminum can production has met one of the Division's goals to achieve sustainable containers, packaging materials, and systems. At 40 to 50 percent, aluminum beverage cans already have a relatively high level of recycled content. In addition, aluminum beverage cans have been light-weighted approximately 20 percent in the last 15 years. Finally, the aluminum sheet scrap that is generated during can production is shipped back to the secondary smelter to remelt into new cans.

There are still areas in which there could be improvements in aluminum can production, including energy use and volatile organic compound (VOC) emissions. It takes a significant amount of energy to produce aluminum cans. Cans are baked at different points in the production cycle. VOC emissions result from can-making processes that use compressed air, coatings, lacquers, varnish, and printing inks. Can manufacturers follow US EPA emission standards for the surface coating of metal cans. The grant program could support further improvements in the sustainability of aluminum beverage containers through projects that would reduce energy use and VOC emissions in aluminum can production, research potential process improvements through the aluminum life-cycle, or compare aluminum to other materials.

Section 3

Glass

3. Glass

The 2007 Market Analysis identified four key challenges related to glass markets: (1) a lack of recycled glass markets in Southern California; (2) increasing quantities of contaminated glass from single stream curbside; (3) large quantities of unused glass fines; and (4) a relatively closed system for glass processing. Two years later, these challenges remain essentially the same.

The fact that glass markets have been relatively stable is actually a testament to the strength of glass recycling markets in California. While metal, plastic, and paper recycled markets have suffered tremendously over the last six months, glass markets "march on". Recycled glass markets never experienced the dramatic highs that occurred for the other three material types in the summer of 2008, but neither have recycled glass markets experienced the even more dramatic lows that started in the fall of 2008.

A. Material Flows and Market Players

Recycling rates for CRV glass have increased each year since 2003. In 2008 the recycling rate was 76 percent. This rate represents the highest glass recycling level achieved in the Program's history, and the largest total number of containers recycled during a 12-month period, 2.5 billion. The previous high glass recycling rate of 75 percent, was achieved in 1993. **Figure 3-1,** on the next page, provides CRV glass recycling, sales, and recycling rates since 1990.

Figure 3-2, on page 3-3, illustrates the general flow and quantities of glass in California in 2008. Almost three-quarters of glass containers recycled are CRV. Most CRV glass is recycled through recycling centers, while most non-CRV glass is recycled through curbside programs. Forty-three percent of glass recycled in California in 2008 was through curbside programs. Most of this glass is mixed – that is, not color-sorted.

Figure 3-2 identifies the top ten processors that handled glass in 2008. The two beneficiating processors are listed first, followed by eight other large processors, in alphabetical order. There are two very different material flows for color sorted and single stream glass. Color sorted glass is generally collected at the recycling centers, and shipped to a non-beneficiating processor, as color sorted glass. The non-beneficiating processor combines the color sorted glass from many recyclers, and ships this glass to the beneficiating processor. After additional processing at the beneficiating processor, most color sorted glass is sold to glass container manufacturers. In some cases, recycling centers ship color sorted glass directly to the beneficiating processor.

Table 3-1, on the next page, provides the percent of glass, by color, for 2004, 2006, and 2008. Reflecting increases in single stream curbside collection, there was a significant increase in mixed color glass between 2004 and 2006. This trend reversed between 2006

Figure 3-1
Glass Beverage Containers Sold and Recycled (1990 to 2008)

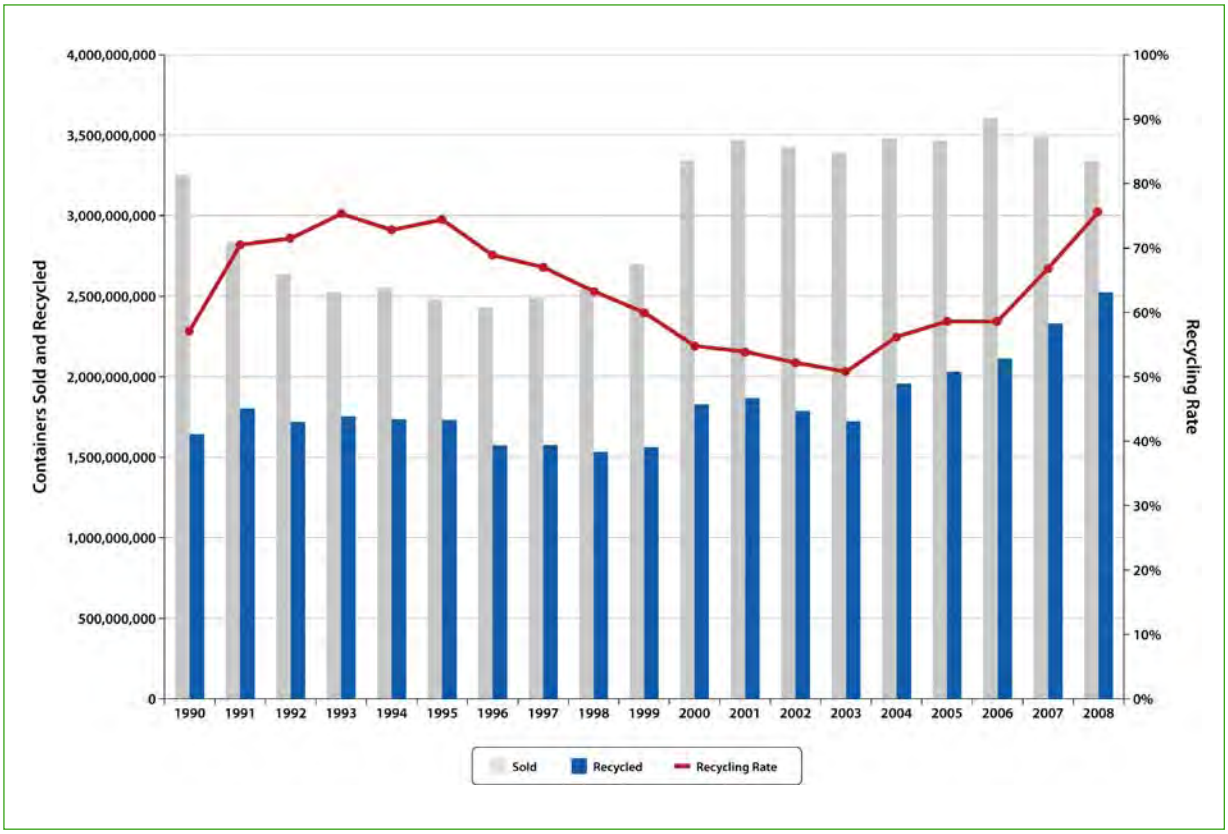


Table 3-1
Processor Glass Purchases by Color (2004, 2006, and 2008

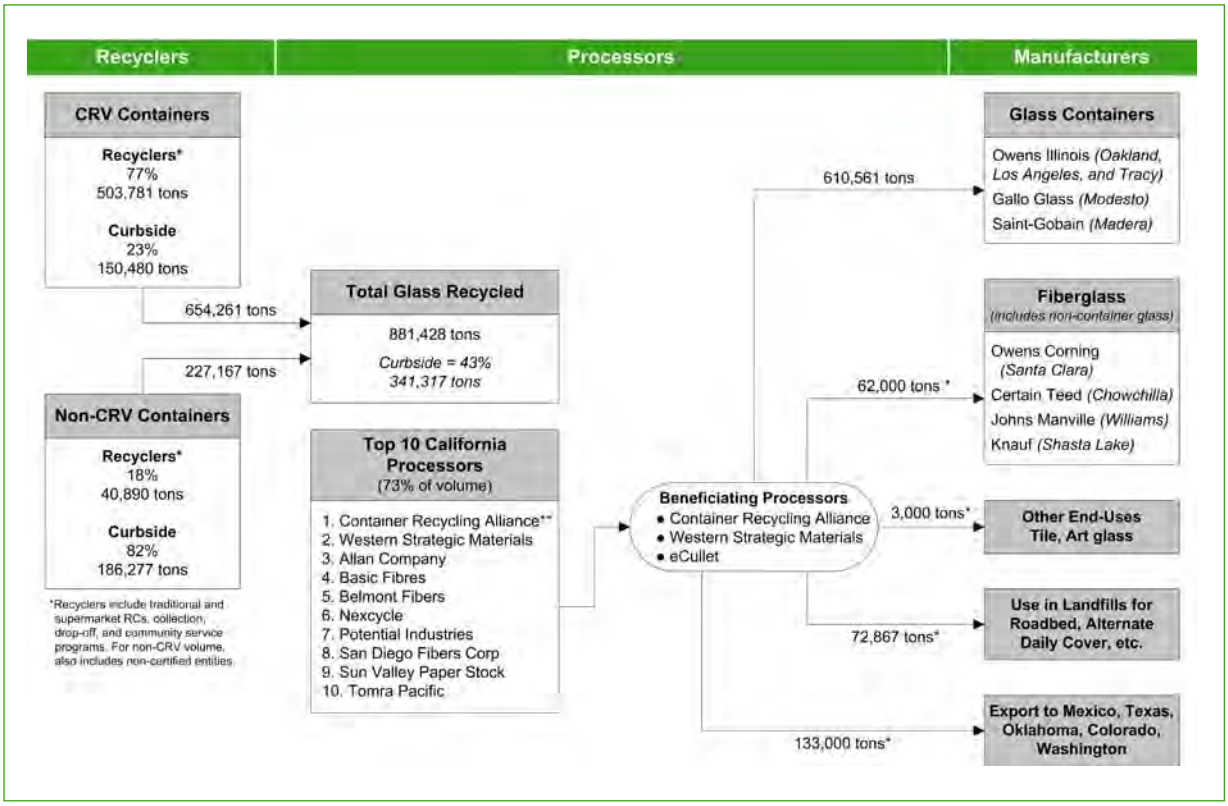
Color	2004	2006	2008
Mixed	38%	49%	43%
Amber	22%	17%	21%
Green	11%	13%	13%
Flint	29%	21%	23%

and 2008, due to technology improvements at beneficiating processors to color sort glass. The DOR's Quality Incentive Payment (QIP) to processors that color-sort curbside glass has been a major factor in increasing the amount of color sorted glass in the State.

Single stream glass is generally shipped by the MRF directly to the beneficiating processor. If the level of contamination is less than 10 percent, the processor follows a DOR-specified procedure to deduct the percent of contamination in order to calculate CRV and processing payments. If the level of contamination is above 10 percent, the processor follows a DOR-approved methodology to determine the amount of contamination, and the resulting CRV and processing payments.

Beneficiating Processors - Beneficiating is the process of crushing and cleaning glass for the end-user. This additional processing step is necessary to make the material suitable for glass and fiberglass manufacturing. Until the mid-1990s, beneficiating facilities were located on-site at glass manufacturers. Glass manufacturers sold

Figure 3-2
Glass Recycling and End-Uses in California (2008)



Note: End-use tonnages are estimates (with the exception of glass containers).
Total glass recycled is based on received weight from recyclers prior to processing.

* Estimated quantities.

** Container Recycling Alliance was purchased by Western Strategic Materials in early 2008.

their beneficiating capacity, primarily for environmental and economic reasons. Two companies, Western Strategic Materials, and Container Recycling Alliance (CRA) operated glass beneficiating facilities in California. These two companies competed at both ends of the process – for material from recyclers and processors, and for customers among glass and fiberglass manufacturers. Essentially all glass recycled in California went through one of these beneficiating processors.

Over the last several years, both Strategic Materials and CRA received grants, and invested their own funds, in technologies to improve the cleaning, sorting, and use of smaller sized glass fines.[1] These investments have increased the amount of glass that can be utilized in the fiberglass and glass container industries. As Table 3-1 illustrates, these investments also appear to be reducing the amount of lower-value mixed color cullet.

In 2008, Western Strategic Materials, the larger of the two beneficiating processors, purchased their competitor, CRA. Strategic Materials now operates

[1] Glass fines are the name given to the small pieces of glass that sift through the processing screens. They are typically smaller than ¼ or 3/16 inch in size. Strategic Materials received a grant to process glass down to 1/8 inch, although implementation is currently on hold. Glass fines are mixed with similarly small pieces of dirt and other contaminants. One way to increase the amount of glass available for recycling end-uses is to clean smaller glass fines.

beneficiating processing facilities in San Leandro, Hayward, Sacramento, Commerce, and Madera. Strategic Materials now handles essentially all recycled glass in California. The exception is glass processed by eCullet, a start-up company in the San Francisco Bay Area that has developed a proprietary glass processing technique to produce glass suitable for container manufacturing.

eCullet currently operates one beneficiating processing facility in Oakland, and one in Seattle. eCullet has received several DOR grants to support development of their technology. Their system removes contaminants and color sorts broken glass from single-stream curbside collection. eCullet's system can color sort glass between ¼ inch and 2 inches in size. As most single-stream glass is now sold as lower-value mixed color cullet, continued expansion of eCullet's system could provide more color-sorted glass for glass container manufacturers in the State.

eCullet is developing modular systems that could be placed on location at MRFs, or moved between MRFs. These systems will reduce transportation costs, an important factor for glass generated at remote locations in the State. Currently, MRFs are paying to ship contaminated recycled glass to beneficiating facilities. Since as much as 40 percent of the material is contaminants, MRFs are essentially paying to ship "garbage". If the material is cleaned on site, then only the clean portion of the glass will be shipped to a container manufacturer. The remaining trash can be sent to local landfills.

Glass Container Manufacturers – California has three glass container manufacturers, with a total of five glass manufacturing facilities. Owens Illinois (O-I) North America Glass Company has plants in Oakland, Tracy, and Los Angeles. Saint Gobain has a facility in Madera, and Gallo Glass has a facility in Modesto. Saint Gobain closed two glass plants in Southern California in 2004 and 2006, creating a market imbalance for generation and use between Northern and Southern California that remains today.

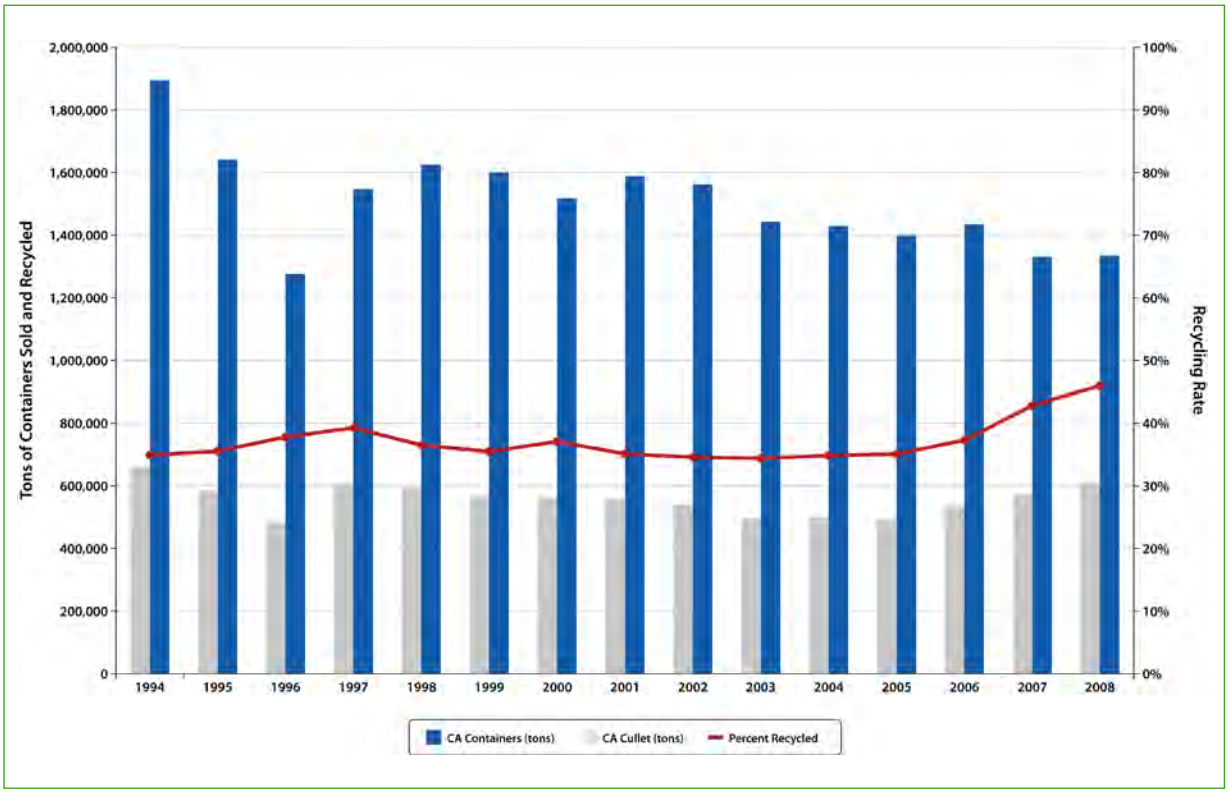
California has a recycled content law that requires glass manufacturers to use at least 35 percent recycled glass in their containers (or 25 percent if using mixed color glass). In 2007, glass manufacturers achieved an average of almost 43 percent recycled content. **Figure 3-3**, on the next page, provides the tons of recycled glass, total glass, and percent recycled content from 1994 to 2007. Recycled content levels in 2007 were the highest levels yet achieved. Recycled content levels in 2008 were even higher, at almost 46 percent.

Glass manufacturers achieve significant energy and emission reductions, and cost savings, by using recycled glass in their furnaces. Generally, glass manufacturers seek to maximize the use of recycled glass, balancing the quality and quantity of glass. Quality is a significant concern, as small pieces of ceramics, metals, or other contaminants can damage the glass furnace and/or result in unusable containers. A May 2009 article in *Resource Recycling,* by Paul Smith of O-I, summarizes the benefits and problems associated with using recycled glass. The key problem, from a glass container manufacturer's perspective, is lack of quality material due to the prevalence of single stream curbside collection.

Glass containers range from 15 percent to 80 percent recycled content. At the national level, average recycled content is approximately 35 percent. The Glass Packaging Institute (GPI) recently set a goal of achieving at least 50 percent recycled content by 2013. As the amount of contamination in recycled glass is decreased, the percent of cullet that glass manufacturers can utilize increases.

There are times when glass manufacturers must use higher levels of recycled glass, and are willing to pay for it – for example, a "sick furnace" that cannot run at the usual high temperatures, can still operate with recycled glass. Rather than having to shut down the furnace, manufacturers outside of California may pay as much as $120 per ton (including transportation) for high quality California recycled glass.

Figure 3-3
California Glass Container Production and Recycled Content (1994 to 2008)



Fiberglass Manufacturers – Fiberglass manufacturers play an important role in California's glass markets. For the glass container industry, the glass must generally (except for Gallo) be color sorted, and the primary contaminant problems are due to ceramics and Pyrex. For the fiberglass industry, glass can be mixed color, and the primary contaminant problems are due to organics. The two industries utilize different glass recycling streams, and together, provide strong markets for most of the glass generated in the State. Fiberglass provides a high-value end-market for curbside glass that cannot be utilized in the container industry.

The fiberglass industry is also subject to a recycled content requirement. Fiberglass must use 30 percent recycled glass. In 2007, California's four fiberglass manufacturers, all located in the northern part of the state, utilized 109,000 tons of recycled glass, for an average recycled content level of 33 percent. This was significantly lower than the 145,000 tons of glass utilized by the fiberglass industry in 2006; however, the decline appears to be due to lower total production, not lower utilization of recycled glass. The fiberglass industry utilizes container glass, sheet glass, and other glass to meet their recycled content standard. Annual container glass use for fiberglass is currently at 62,000 tons.

While the fiberglass industry has been hit hard by the downturn in the housing market, manufacturers have been able to increase their use of recycled glass due to the improved quality of recycled glass cullet. The primary concern related to use of recycled glass for fiberglass manufacturers is contamination from organic material. Recycled glass must contain less than one percent organic

contaminants. As long as these contaminants can be removed from glass fines (now down to as low as 3/16 inch), fiberglass manufacturers can utilize this small-sized mixed color cullet. If clean glass is available, fiberglass manufacturers can utilize up to 50 percent recycled content.

Tile, Countertops, and Other Art Glass Manufacturers – There are a few California companies that utilize recycled glass to produce high value-added products. The two largest companies, Vetrazzo in Richmond, and Fireclay Tile in San Jose, have both received DOR grants to develop products and expand capacity. Both companies' products fit within the green building category. With the advent of the green building movement, Vetrazzo and FireClay Tile's products, such as recycled glass countertops, have moved from unique niche markets to mainstream popularity. While these markets are relatively low volume, they make up for the lack of volume with high-value.

Vetrazzo produces recycled glass countertops, with colored glass embedded in a patent-pending formula utilizing cement. Countertops use only 100 percent recycled glass which makes up 80 to 85 percent of the material. The mix is poured into recycled paper molds, cured in a kiln, and polished like slabs of granite. Finished slabs weigh approximately 700 pounds. They are shipped to dealers around the U.S. and Canada to be cut into countertops and other products.

Because the recycled glass in Vetrazzo countertops is highly visible, their products serve to spread the message of recycling and upcycling. Over the last several years, the company has received extensive press in home and architecture venues, as well as winning a recent Environmental Achievement award from the U.S. EPA. Vetrazzo continues to expand production capacity to meet demand. Vetrazzo plans on building another plant on the East Coast by 2012. Vetrazzo currently utilizes about 1,200 tons per year of recycled glass (CRV and non-CRV). They plan to double utilization by the end of 2009, and plan to utilize approximately 7,200 tons per year of recycled glass by 2012.

Fireclay Tile began to use recycled glass baghouse dust from a recycled glass processor almost ten years ago in their Debris Tile line. These tiles currently use 50 percent recycled materials, combining the glass dust with granite dust from a rock crushing facility near their Aromas plant. In 2007, with assistance from a DOC grant, Fireclay developed a single slab countertop product (Bottlestone) made with relatively coarse mixed color recycled glass (about $1/10^{th}$ of an inch and smaller). The countertops combine concrete-type mixing processes and ceramic firing innovations to produce larger size pieces than are possible with traditional ceramics. The glass in Fireclay's products supplies the final binding strength.

Fireclay is currently implementing a second DOC grant to help fund a larger furnace that will increase their capacity to produce tile and countertops. Fireclay's goal is to reach an average of 80 percent recycled content over all of their product lines.

Fireclay currently utilizes approximately 500 tons per year of recycled glass dust. By 2010, they expect to utilize 2,500 to 3,000 tons of both dust and coarser glass, and by 2012, 5,000 tons. A major advantage of Fireclay's process is that they utilize glass fines that would otherwise be landfilled. Using recycled glass in these products also reduces energy required for firing.

Fire & Light, in Aracata, produces glass tableware using 91 percent recycled content. Fire & Light sources clear glass from the Arcata Community Recycling Center. Their product utilizes small quantities (approximately 200 tons per year), but has a high value, provides a local end-market, and creates local jobs.

Another glass tile company, Oceanside Glass, recently moved their production facility from Carlsbad to Mexico.

The economy is not conducive to start-up companies at the moment. However, given the current popularity of green building products, it is possible that new California companies will explore the use of recycled glass in home building products over the next several years. High value, low volume glass end-markets provide an attractive alternative to large-scale glass container and fiberglass markets. These markets generate more jobs, and greater value-added, than containers and fiberglass. Finally, when located in markets that are distant from metropolitan areas, such as Arcata, they minimize shipping, which is particularly significant for glass.

Figure 3-4, on the next page, compares California's current (2009) recycled container glass end-uses with potential "best" case scenario container glass end-uses in 2012. This future scenario is based on a number of assumptions. First, the DOR will maintain QIP payments for color-sorted glass, in order to help meet the needs of the glass container industry. Second, California will develop and expand end-use markets in three areas: (1) tile, countertops, brick, and art glass; (2) concrete products; and (3) blasting media. Third, this scenario assumes that the economy will have improved by 2012, resulting in increased sales of glass containers and fiberglass, which in turn will increase demand for recycled glass in both of these markets. Finally, this scenario assumes that the beneficiating industry will continue to reduce the size of glass fines, down to 1/8 inch. Under the 2012 scenario, there will be a shortage of recycled glass, unless glass container recycling increases. In order to recycle 965,000 tons of glass, both CRV and non-CRV recycling, such as wine bottles, would need to increase significantly.

B. Current Market Dynamics

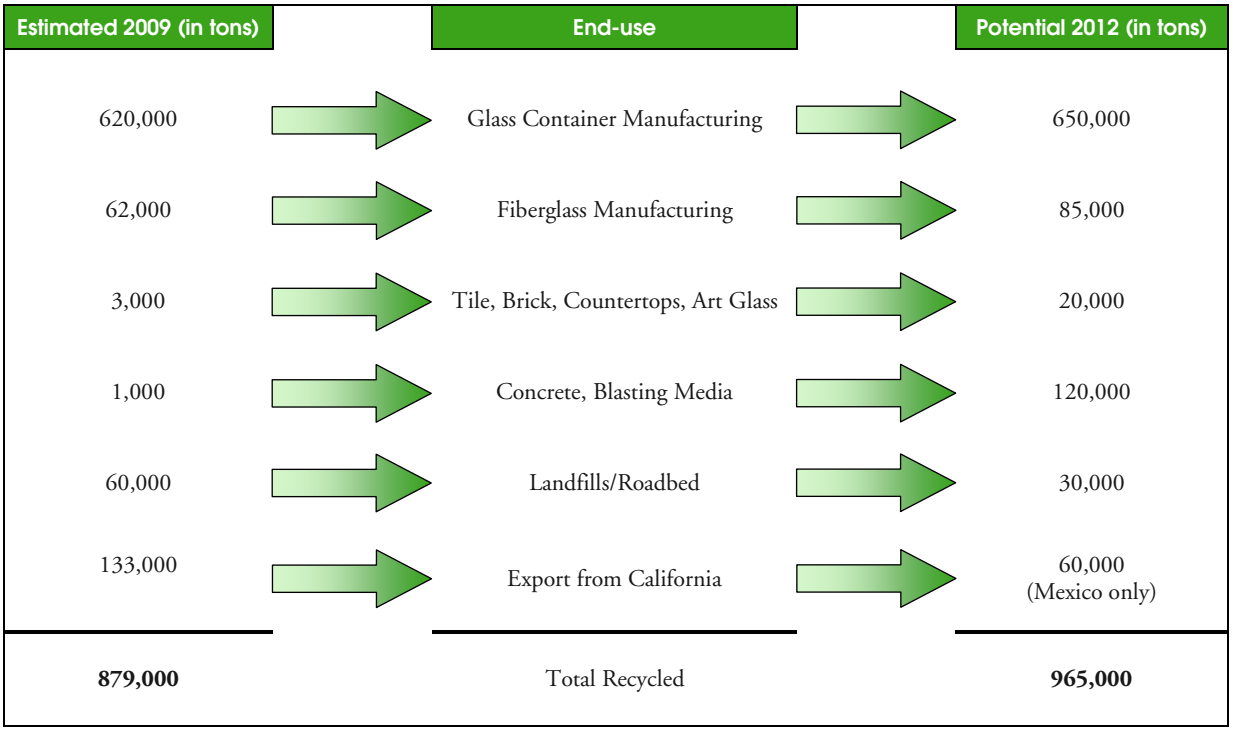
Given the recent fluctuations in the economy in general, and in recycling markets in particular, recycled glass markets are doing well. Demand for recycled glass is strong, and prices have been stable. Industry experts described glass markets using adjectives such as "boring" and "steady" – in contrast to terms such as "tumultuous" or "challenging" for aluminum and plastic markets. The slow economy has resulted in decreases in the production of both glass containers and fiberglass; however, manufacturers in both of these industries have increased the percent of recycled glass they are using, so that demand for recycled glass has not declined. In addition, niche end markets for recycled glass are growing.

There are still four key challenges related to glass markets: (1) lack of Southern California glass markets; (2) contaminated glass from single stream curbside; (3) unused glass fines; and (4) limited glass processing alternatives. These challenges have shifted somewhat from two years ago; however, they remain the key issues related to recycled glass in California. A fifth issue that is becoming a problem for glass is the use of plastic labels.

1. Lack of Southern California Glass Markets

All four fiberglass manufacturers, and four of the five glass container manufacturers, are located in Northern California. The majority of the State's population is located in Southern California. The result is an imbalance between generation and utilization of recycled glass in the State. A fraction of the recycled glass generated in Southern California is utilized by the O-I facility in Los Angeles. The remaining glass is shipped to Northern California, to glass manufacturers in Mexico, or to glass manufacturers out-of-state. Currently, over 133,000 tons of glass are being shipped out-of-state on an annual basis, with approximately 45 percent of that glass going to Mexico, and the remainder to Washington, Texas, Oklahoma, and Colorado. This represents a 70 percent increase over estimated shipments in 2006.

Figure 3-4
Comparison of 2009 California Glass End-use to Potential "Best" Case 2012 California Glass End-use



For the most part, this geographical imbalance results in an inefficient utilization of recycled glass. Because glass is heavy, it is expensive to transport glass long distances. Glass transportation costs range from $20 to $45 per ton. The exception is glass going into Mexico. Much of the glass going to Mexico (all of the amber glass) travels a relatively short distance and returns to the State – from San Diego, to Mexicali, into glass containers, and then back to Anheuser-Busch in Southern California to be filled. Even though this glass goes out-of-the-country, Anheuser-Bush pays processing fees on these containers, and the glass is still part of the California redemption system.

It is unlikely that new glass manufacturing facilities will locate in Southern California to fill the void left by the closure of St. Gobain facilities in 2004 and 2006. The most likely way to alleviate the supply/demand imbalance is to develop alternative markets, such as concrete products and blasting media, in Southern California. When the economy rebounds, perhaps in 2010 or 2011, it is likely that out-of-state glass shipments will decline.

2. Contaminated Glass from Single Stream Curbside

In 2008, 43 percent of glass containers were collected through curbside programs. The vast majority of this material was collected through single stream programs. The transition of curbside programs to single stream collection in California is nearly complete, with very few major cities still collecting dual stream or color-sorted glass. Thus, the amount of mixed glass generated in the State should be stabilizing.

The benefits of single stream curbside are that it increases diversion and reduces collection costs. However, single stream collection reduces quality and shifts the cost of curbside collection from the

hauler to the processor. The quality concerns related to single stream have been discussed in numerous reports and articles. These concerns are greatest for glass and paper. First, glass is crushed in the collection trucks, so that pieces of glass become mixed in with other containers and paper. Second, glass is further broken in handling, starting when the truckload of recyclable materials is dumped onto a concrete pad at the MRF. Third, pieces of glass are mixed in with paper, contaminating recyclable paper. Fourth, glass is negatively sorted. This means that the other materials (cans, plastic bottles, and paper) are sorted off the conveyor, and glass and any contaminants are left behind. This glass residual may contain as much as 40 percent contaminants.

A significant portion of the $18 million in Market Development Grants awarded for glass projects, and the nearly $16 million awarded for multi-material projects, address the issue of cleaning and sorting single stream glass. These projects address the problem from multiple directions – from identifying procedures to reduce the amount of breakage during collection and processing, to funding equipment to clean and sort the contaminated glass material from the MRF lines. While these projects, along with the QIP, have resulted in important quality improvements, single stream mixed color glass still is a significant market issue.

Recently, the quality of single stream glass has declined further. The poor economy has resulted in declining beer sales. In addition, more consumers are returning containers at buyback centers, instead of in their curbside bin. On the positive side, more CRV glass beverage containers are being recycled at buyback centers, which results in higher quality glass. However, at the curb, there is less good-quality CRV glass, and thus a higher percentage of contaminants. Recently, average curbside glass contamination has increased from 20 percent to 40 percent. Higher contamination levels increases the cost of cleaning the material, reduces the amount of useable glass, and increases the amount of glass ultimately going to landfill.

The increased single stream contamination has been made worse by the suspension of QIP payments. Because of budget concerns, the DOR has suspended many programs, including QIPs. Under the QIP, beneficiating processors (and a few other processors) received up to $60 per ton of color-sorted curbside glass. This program resulted in color sorting of significantly more curbside glass, thus more glass going into glass container end-markets. Without the QIP, it is unlikely that processors can continue to color sort the same quantities of curbside glass.

It will take more than back-end technologies to clean up single stream glass. There is ample room for improvement in single stream systems. Single stream material could be improved through customer education, enforcement when inappropriate materials are put into recycling bins, reduced compaction on collection trucks, and improved handling to reduce breakage (see the DOR Publication, *Single Stream Best Practices*).

3. Unused Glass Fines

In 2005, any glass less than 3/8 inch was used for roadbeds or alternative daily cover in landfills. This material was essentially landfilled, not recycled. By 2007, the size of glass fines going to landfills was down to ¼ inch or smaller. Currently, glass fines of less than 3/16 inch are sent to landfills, although in warmer weather, when there is more moisture, glass fines may be larger.

The next target is to reduce glass fines down to 1/8 inch, which would decrease the amount of fines going to landfills by approximately 70 percent. Strategic Materials estimated that the new sorting and cleaning process for 1/8 inch fines implemented at three of their facilities would increase the amount of glass utilized by 29,000 tons per year. If implemented at all beneficiating facilities in the

State, this process could result in approximately 50,000, or more, tons of glass annually that could be recycled, rather than landfilled.

The amount of glass going to landfills as roadbed or alternative daily cover has decreased substantially – from an estimated 95,000 tons a year in 2006, to just under 73,000 tons per year in 2008. However, through improved processing and new end-use alternatives, the amount of glass going to landfills could be reduced even further.

4. Limited Glass Processing Alternatives

The glass beneficiating industry has always had relatively few players. In 2008, Strategic Materials purchased CRA, consolidating the two companies and five beneficiating facilities in the State under one company. The only other company with beneficiating processing technology in place is eCullet; however, their Oakland facility currently handles less than five percent of the total glass generated in the State. At this point in time, Strategic Materials handles almost all glass recycled in California.

There are several reasons why the number of beneficiating processing facilities is so small. First, cleaning and processing glass to meet glass container and fiberglass end-use specifications is difficult and expensive. Since the advent of single stream curbside, glass cleaning has become even more costly, and more technically challenging. There is a relatively small margin in the industry. The industry also depends heavily on established relationships. Beneficiating processors purchase glass from recyclers and processors, and sell glass to end-users. It is very difficult for new companies to break into either side of these buyer-seller relationships. Finally, the flow of containers and money within California's Beverage Recycling Program favors large-scale processing, rather than small-scale processing operations.

There are some benefits to a relatively closed processing system. Since Strategic Materials has taken over essentially all beneficiating processing in the State, many in the industry believe that Strategic has been more responsive to end-use customers, particularly smaller customers, than they were previously. Strategic has been more active in evaluating alternative markets in the last year. Others note that there are some economics of scale and synergies that result from a single beneficiating processor. In addition, Strategic Materials is technically proficient, and has a good understanding of their industry.

However, the fact that there is essentially one company that purchases all recycled glass from recyclers and processors, and sells all recycled glass to end-users, raises some concerns. Some recyclers and processors said that their prices for recycled glass have dropped since Strategic and CRA merged (although on average, this is not clear in the scrap data). There also is a vague apprehension among many in the industry about one company having such dominant control of the market. There are no problems now, but what if the situation changes? What if management changes? There is reasonable supply and demand balance at the moment, but what will happen if demand for recycled glass increases? At this point, there is no way to answer these questions.

There may be additional glass processing capability in the State over the next several years. eCullet plans on expanding to MRF locations throughout the State. TOMRA Pacific received a DOC grant to build a 90,000 ton per year glass beneficiating facility in Commerce. When it is completed, the TOMRA facility will primarily handle glass collected at TOMRA recycling centers. O-I received a DOC grant to add processing capability to further clean cullet at their Tracy plant, and Vetrazzo received a DOC grant to add small-scale glass processing to meet their specifications. As of June 2009, all DOC grants are currently on-hold.

5. Plastic Labels on Glass Bottles

Several end-users commented on problems resulting from plastic labels. A few beverage manufacturers use plastic labels as a marketing distinction. Plastic labels cover more of the bottle, and it is difficult to sort and remove plastic labels from glass bottles. Plastic labels are contaminants in glass container manufacturing, fiberglass, and high-value products such as countertops. Because plastic is petroleum based, it will flare up in glass furnaces and increase the amount of heat generated. Beverage manufacturers should be discouraged, or some would recommend prohibited, from using plastic labels on beverages in glass containers.

C. Market Influences

The market influences for glass are much more local than for aluminum and plastics. There is no LME or global market for glass. On the recycling side, the key factors influencing price are the quality and color of the material. There are strong markets for clean, color-sorted glass. There also are good markets for mixed-color single stream curbside glass; however, it is expensive to clean the material to end-use specifications.

On the end-use side of the equation, the driving factors are the cost of alternatives. For the most part, this means the cost of sand, soda ash, and/or lime. Sand costs $20 to $35 per ton. Soda ash costs approximately $275 per ton. Soda ash is supply limited; most soda ash in the United States is mined in Green River, Wyoming. Generally, clean, processed cullet must typically be less than the price of the combined ingredients of glass, which are approximately $60 per ton. The cost to clean and process curbside glass is approximately $40 per ton, and less for color-separated glass. This excludes transportation costs. Depending on the distance and the price of fuel, the cost of shipping glass can be $20 to $45 per ton. Thus, there is very little margin in the price of recycled glass.

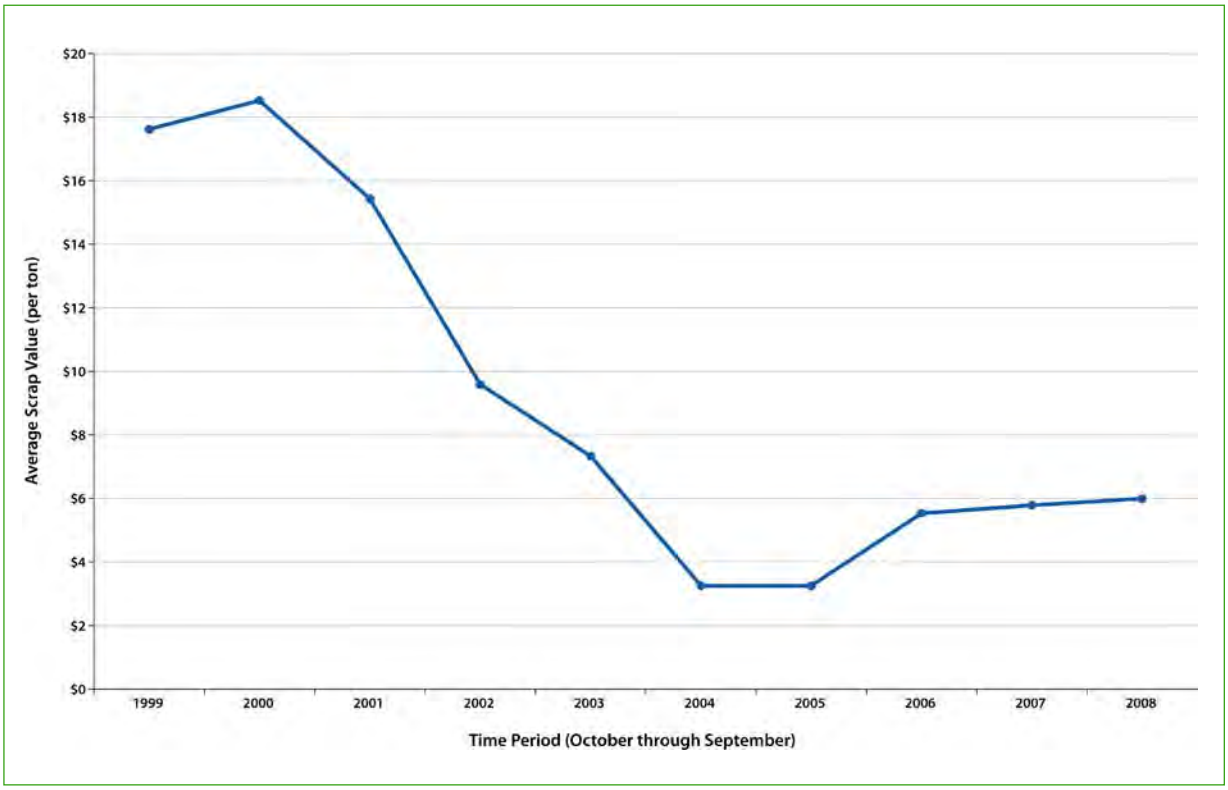
Because the costs of substitutes are relatively stable, the scrap value of recycled glass has not changed significantly in the last several years. **Figure 3-5,** on the next page, provides the calculated statewide average annual scrap value for glass from 1999 to 2008 (for the period October through September). This statewide figure represents the average of color sorted (flint, green, and amber) glass, and mixed color single stream glass. This blended figure does not actually represent the scrap value of any of these categories, because it averages negative values of the mixed single stream glass (i.e., recyclers pay processors to take the glass), with positive values of the color sorted glass. Figure 3-5 clearly illustrates a decline in average scrap value due to the onset of single stream curbside, starting in 2001. Over the last three years, the statewide average scrap value has been steady at just under $6 per ton.

The actual price of glass varies by color. **Figure 3-6,** on page 3-13, provides the average weekly prices paid to recyclers for delivered, color-sorted glass in California and Nevada, over the last four years. With the exception of an increase in the price for flint glass in 2008, color-sorted glass has been very stable. Green glass has the lowest value, at around $7 to $10 per ton. Amber glass has a value of $17 to $20 per ton, and flint glass has a value of $27 up to $45 per ton. Not shown in the figure, single stream mixed color glass (MRF glass) has a negative scrap value, sometimes as high as -$20 and -$40 per ton, based on the amount of contamination (and thus the cost to clean the material).

Because the scrap value of glass is so low, the DOR payments[2] for glass (CRV, processing payments, and Quality Incentive Payments (QIP)) have a strong influence on material flows and markets, particularly for curbside recycling. DOR

[2] DOR payments for glass are substantial. The CRV payment to curbside programs for one ton of glass is approximately $50. The processing payment for one ton of glass is almost $100. For glass, the QIP of up to $60 per ton is paid primarily to beneficiating processors, who color sort mixed glass.

Figure 3-5
Glass Average Scrap Values (1999 to 2008)



regulations (Public Resources Code Section 2425(h)) require processors to inspect loads of commingled glass that they purchase to determine eligibility for refund value and the level of contamination in the load. The processor will reduce the weight of the load for shrinkage, as appropriate, if the load has residual or other contamination. If the load has residual or other contamination greater than 10 percent by weight (essentially all curbside loads), the processor must request an alternative method of preparing the shipping report (DR-6) from the DOR. Strategic Materials and a few other larger processors have approved alternative methodologies.

Unfortunately, this system is extremely difficult to monitor and enforce. Loads of mixed glass can be divided into three fractions: "garbage", good glass, and mixed glass with fines. The DOR pays refund value on the good glass and mixed glass with fines. However, the mixed glass with fines includes some amount of dirt and other non-glass particles. Thus, depending on the amount of non-glass material in the glass fines, CRV is being paid on non-glass material.

Under the alternative methodology, in order to determine how much CRV to pay the MRF, processors typically conduct sampling once a year to calculate an average percent contamination for each program. Once the percent contamination is determined, there is no incentive for the MRF to provide glass that is cleaner than the sampled percentage. MRFs may in fact generate more contaminated glass, and receive the same payments. At the same time, the processor wields significant control, because they determine not only the price of scrap, but the amount of material on which scrap (and CRV) is paid.

Figure 3-6
California and Nevada Weekly Prices for Glass, by Color, Delivered (April 2005 to May 2009)

There is no clear solution to this problem. The weight-based CRV payment system was established for buyback centers. At buyback centers, the material is clearly glass, and is clearly attributed to a particular customer, and then recycler. With curbside recycling, a single MRF may sort materials from several curbside programs. The extent to which glass is commingled, crushed, and contaminated varies between programs. It is impossible to accurately and consistently determine exactly how much glass in a particular load is CRV glass. As a result, the DOR must rely on sampling and averages in order to determine how much curbside CRV glass is recycled.

The QIP for color-sorted glass has been effective in increasing the amount of color-sorted recycled glass. This glass can be utilized by container manufacturers. Increased availability of clean color-sorted glass is the limiting factor in increasing recycled content of glass containers. To the extent that more curbside glass can be color-sorted, then more curbside glass can be utilized in new glass containers.

D. New Market Alternatives and Opportunities

New alternatives and opportunities for glass should address the ongoing market issues: lack of Southern California markets, landfilling of significant volumes of glass fines, and limited processing opportunities. At the same time, it is important to support the existing glass infrastructure: the health of the large-volume glass container and fiberglass end-markets is essential to

glass recycling in the State. Some recyclers and processors were concerned that with only two glass container manufacturers, there are limited end-use options for glass. The glass container industry has shrunk considerably over the last fifteen years, but seems to now be stabilizing.

1. New End-Use Alternatives

The lack of Southern California markets, and increased use of glass fines can be addressed through new alternatives. There are a number of other potential uses of recycled glass that could provide viable markets, in some cases for glass fines that are currently used as landfill cover or roadbeds. None of these alternatives are technically "new", although if developed in California, they would represent new markets. A key barrier to any new glass alternative is the cost of cleaning dirty glass.

The rapid growth of the green building movement is a positive development for recycled glass markets. Many of the potential markets for glass, such as fiberglass, countertops, and concrete blocks, are "green building" products. We briefly discuss several recycled glass market alternatives that have not yet been developed in California, below.

Cement and Construction Fillers – Recycled glass can be used as a substitute for sand in concrete applications. The glass must be clean, with a low percentage of sugars or other organic contaminants. Strategic Materials is working with a California start-up, GreenDay LLC, and cement block companies, to determine quality and quantity requirements. In cement blocks, recycled glass fines would directly replace a percentage of natural sand. Two cement block companies in Southern California, and one in Northern California, are committed to the project. The company successfully tested clean mixed glass fines, 1/10 inch and smaller, in cement block. The potential volume of glass to fill just the cement block industry needs is over 200,000 tons per year. While the company is currently focusing on cement blocks, there are numerous cement-based applications for recycled glass, such as cement roof tiles, cement wall boards, concrete pavers, highway projects, and stucco.

Another project is evaluating glass powder fines, ground to the size of talcum powder. These fines can be cleaned, washed, and dried for use as pozzolan fillers for construction related projects. A pozzolan is a material that becomes cement-like when combined with calcium hydroxide. Pozzolans are used in cement to increase fluidity, strength, and durability. Fly ash, rice husk ash, and limestone are commonly used pozzolans. Using recycled glass as a pozzolan would provide large potential markets for glass fines that are currently going to landfills. Contaminants such as organics, paper, and plastic must be removed. The cement industry is interested in using this material to offset carbon production. In addition to adding recycled content, using glass in cement production allows for a lower kiln temperature, reducing energy use.

The federal economic stimulus could increase the need for concrete building projects over the next several years, with an emphasis on green building. Cement-based applications could absorb a significant amount of recycled glass. The greatest potential for glass use is in locations where there are not existing glass container or fiberglass manufacturers, and for glass fines that are too small for most other end-use applications.

Blasting Media – Strategic Materials is currently evaluating the use of recycled glass for blasting media. Glass would be a replacement for sand or slag. There are significant health and environmental benefits to using recycled glass, as compared to either sand or slag. In sand blasting media, the silica is a carcinogen. Slag blasting media contains heavy metals, which also have significant negative health and environmental impacts. The silica within recycled glass is in crystalline form, and is not an irritant in lungs. The National Institute of Occupational Safety and Health (NIOSH) recommends using recycled glass for blasting media.

Blasting media use is widespread – from homeowners, to Caltrans, to shipyards. At the national level, an estimated 500,000 to 900,000 tons of blasting slag is used annually. Blasting media use within any single metropolitan area could be approximately 10,000 tons per year. Thus, this alterative could provide a local market for a portion of the glass generated within a region.

The key processing issue for blasting media is organics. To be suitable for blasting media, recycled glass would need to be cleaned to the same quality level as for the fiberglass industry. This alternative might be attractive in Southern California, where there are no existing fiberglass plants, and only one glass manufacturing facility.

Filtration – Glass can be utilized in swimming pool filtration systems, and in raised-bed sand filters to clean up streams or other waterways. Like sand or gravel, the recycled glass provides a filtering mechanism to remove sediment and other contaminants. In swimming pool filtration systems, glass filtration provides a low-chemical alternative, reducing the need for chlorine and acid. This potential market is not widely used, and relatively small.

Landscape – Larger sized recycled glass – such as pebbles or gravel – can be used in landscaping. Glass is essentially used as decorative mulch. This alternative also fits within green building options. This potential market is not widely used in California, and relatively small. However, it might be attractive in locations that are distant from more standard glass end-use markets.

Home Products – Recycled glass can be used in a number of home products, including countertops, bricks, tiles, and shower stalls. Recycled glass in home products ranges in size from powder (essentially used as a binder), to gravel size. Any product that includes a binder with aggregate or powder would be appropriate for recycled glass. A major benefit of using glass as a binding agent is that the glass must be fine – thus it provides an alternative for glass fines that are currently being sent to landfills.

2. Capturing More Glass Fines

Approximately 15 percent of glass collected from curbside programs consists of glass fines. Until recently, glass fines consisted of glass 3/8 inch and smaller. Current processing technology can capture glass fines consistently down to 3/16 inch. Strategic Materials' goal is to capture fines down to 1/8 inch. This could result in as much as a 70 percent reduction in the amount of glass fines going to landfills. Strategic Materials received a DOC grant to add equipment for this additional processing at three of their five facilities. eCullet is also developing equipment to clean fines down to a lower level. As long as glass fines can be cleaned to end-user specification – removing organic and ceramic contaminants – the material can be used.

3. Small Scale Processing

The large volumes of containers, flow of CRV and other payments, and recycled content laws of California's Beverage Recycling Program create a barrier to entry for small glass processing operations. Small-scale processing cannot, and should not, replace the large-volume glass processing system in California. However, small-scale processing can provide a viable alternative in remote locations, and/or for small-volume, high-value end-markets. The eCullet processing system to be co-located at MRFs, as well as on-site processing being developed by O-I and Vetrazzo, are first steps in this direction.

A major advantage of small-scale processing is that it supports local use, and reduces transportation costs. Rather than ship dirty glass across the State, and then ship clean glass back to end-users, recycled glass can be processed and utilized locally. Small scale processing is especially good for local markets such as tile and art products, blasting media, and landscape products.

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Section 4

PET

4. PET

Over the last several years, recycled PET markets have been the most dynamic of the four major beverage container material types. In 2007, there were five key market issues for PET: (1) potential overcapacity for clean flake and sheet; (2) continued high exports to China; (3) China's role in clean flake and sheet markets; (4) high prices for PET bales; and (5) growing use of bio-resins (PLA), colored PET, and additives. In 2008, and into 2009, recycled PET markets have been on a roller-coaster. Some of these five market issues are still in play, but there are new concerns as well. Today, key issues include the volatility of recycled and virgin PET pricing; challenges for PET reclaiming; high exports to China; decreases in demand for virgin PET; quality of PET bales, barriers, and additives in PET bottles; and demand for recycled content.

A. Material Flows and Market Players

The number of PET CRV containers recycled increased in 2008, as it has every year since the program began. The PET CRV recycling rate increased to 62 percent, the highest recycling rate since new containers were added to the program in 2000. **Figure 4-1,** on the next page, illustrates PET CRV sales, recycling, and recycling rates since 1990.

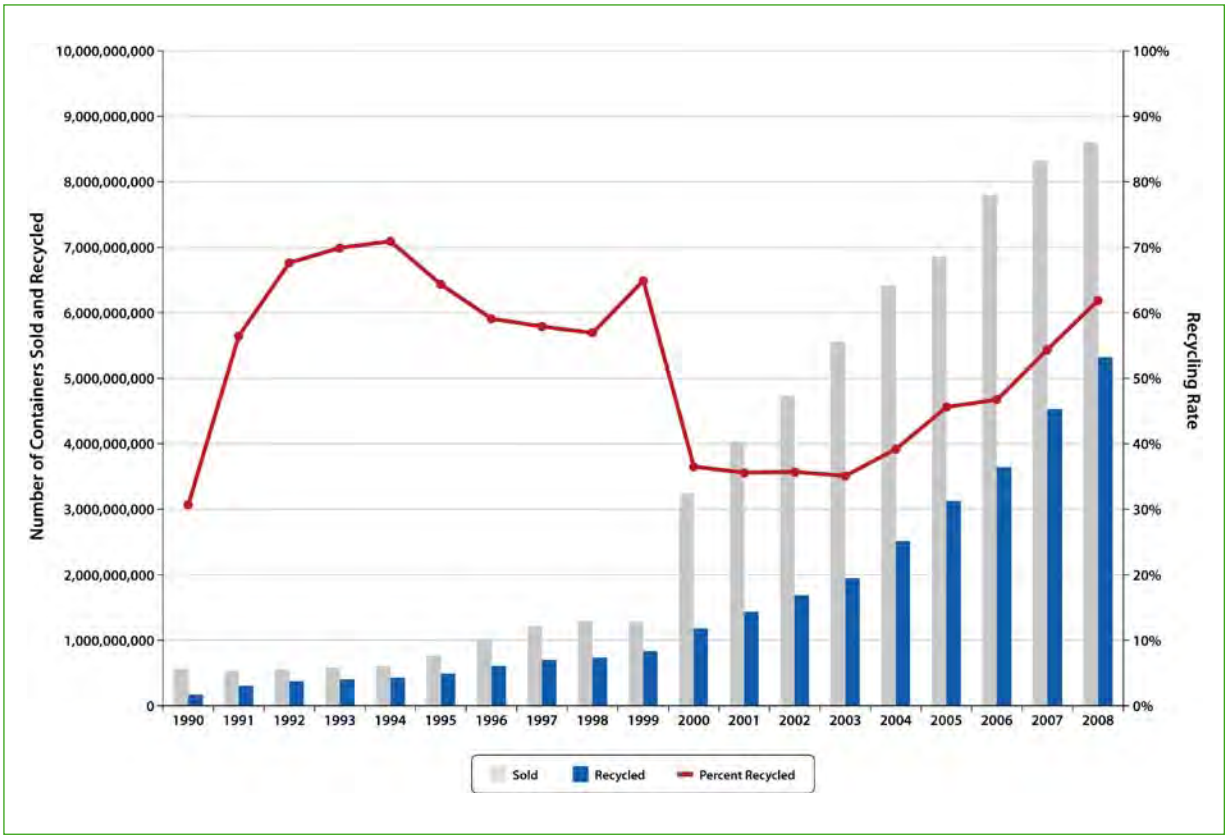
Figure 4-2, on page 4-3, provides the flow of PET from recycling to end-use. Almost 400 million pounds of PET were recycled in California in 2008. Over 93 percent of PET containers were CRV containers. Most PET was recycled at recycling centers; recycling centers handled 88 percent of CRV containers, and 36 percent of non-CRV containers. Curbside programs recycled 64 percent of the non-CRV PET containers recycled, and 12 percent of the CRV containers recycled.

Figure 4-2 identifies the top ten processors of PET, in alphabetical order. These processors handled 60 percent of the PET recycled in the State. Another 86 processors handled the remaining 40 percent of PET recycled. Processors bale the PET, at which point it can take one of four routes.

Most PET recycled in California is exported. The majority of PET is exported as bales, although some PET is exported as dirty (unwashed) flake, or as clean (washed) flake. Exports of baled PET have increased substantially since 2006, from approximately 180 million pounds, to approximately 249 million pounds. According to U.S. Department of Commerce figures, total PET exports from California ports in 2008 were 439 million pounds, a seven percent increase over 2007 levels. While the majority of this figure is California-generated PET, the 439 million pounds also includes recycled PET shipped to California ports from other inland states. In 2008, almost 95 percent of this PET was shipped to China or Hong Kong.

In 2008, California had three companies producing clean PET flake: Global PET, ECO_2 Plastics, and Greenpoint Industries. Essentially all the PET flake produced in

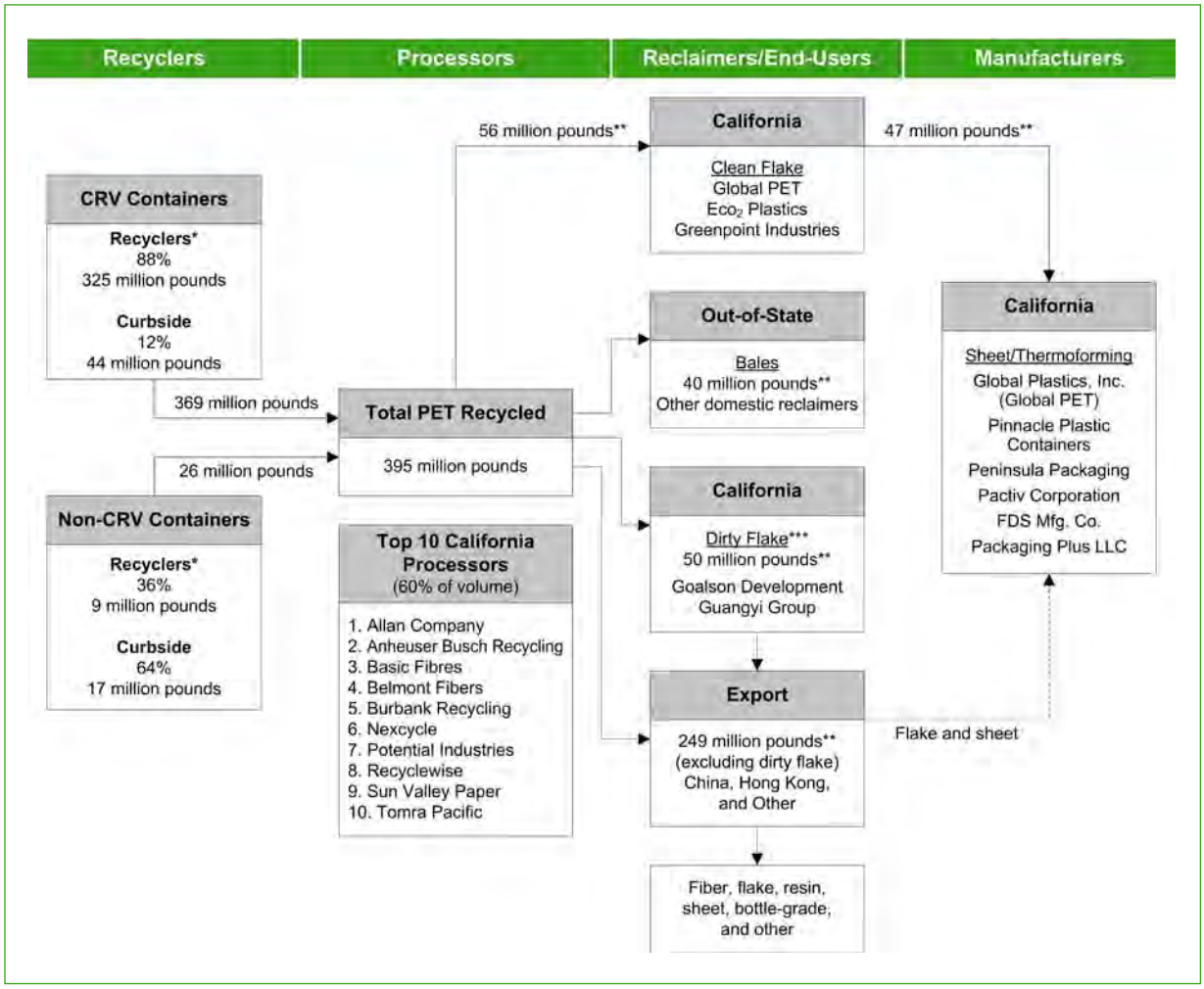
Figure 4-1
PET Beverage Containers Sold and Recycled (1990 to 2008)



California is utilized by the thermoforming industry to produce clear and colored plastic containers, such as clamshells for food and agricultural products. Examples include the clear plastic containers for strawberries, salad mix, and other produce; and colored and clear plastic containers for sushi, baked goods, and other ready-to-eat and take-out food. Together, these three companies purchased approximately 56 million pounds of recycled PET bales in 2008. Because there is significant yield loss when PET is reclaimed, the amount of PET flake produced was lower, at approximately 47 million pounds.

Global PET – Global PET, located in Perris, is the primary producer of washed PET flake in California. Global PET has received several DOC grants, and has expanded their facility from flaking, to washing, to sheet production, and soon thermoforming. Global PET currently purchases approximately 40 million pounds of PET bales per year, and produces PET flake and sheet. They balance the production of flake and sheet, depending on markets. Global PET has capacity to produce 20 million pounds of sheet, split between clear and green. Thermoforming lines to produce clamshell containers will be in place in late 2009. Eventually, the company hopes to utilize 60 million pounds of recycled PET per year, split between producing flake, sheet, and thermoformed product (food containers). Global PET received a FDA (Food and Drug Administration) Letter of Non-Objection (LNO) for food grade PET in 2007. Global PET sells the flake and sheet they produce into the California thermoforming market.

Figure 4-2
PET Recycling and End-uses in California (2008)



* Recyclers includes traditional and supermarket RCs, collection, drop-off, and community service programs. For non-CRV volume, also includes non-certified entities.

** Estimated quantities.

*** Includes some clean flake.

ECO_2 Plastics – ECO_2 Plastics is a publicly traded company located in Riverbank.[1] ECO_2 has developed a dry-wash system for PET using a bio-solvent cleaner. The company has operated "in the red" for many years. Over the last year, ECO_2 has increased flake production, and they expect to be profitable in 2009. ECO_2 received a FDA LNO for multiple categories of food contact for the flake produced from their process. ECO_2 has capacity to utilize 55 million pounds per year of recycled PET bales, but is currently operating well below that capacity.

Greenpoint Industries – located in Rancho Dominguez, is a small PET reclaiming facility. Greenpoint produces clean recycled PET flake for use by thermoformers. The company is small enough that it has not been worthwhile, thus far, to complete the certification and paperwork necessary to receive

[1] In September 2009, while this report was being finalized, ECO_2 Plastics announced they were closing their Riverbank facility.

Table 4-1
2007 National PET End-Use Categories, by Percent

End-Use Category	Percent of Total
Fiber	**42.6%**
Food and Beverage Containers	15.1%
Strapping	16.0%
Film and Sheet	14.2%
Non-Food Bottles	6.7%
Engineered Resin	1.2%
Other	4.2%

DOR's Market Development Payments (MDPs). Greenpoint faced severe challenges during the market crash in late 2008, but is increasing production, and plans to eventually expand to at least 12 million pounds per year.

In addition to the companies producing washed flake for use in California, there are companies that produce and export dirty or washed flake. One such company, AE-Way, went bankrupt in late 2008. During 2006, AE-Way was grinding and shipping just under 2 million pounds per year of PET to China. The other two companies that export flake are Goalson Development Corporation, and Guangyi Group.

Goalson Development Corporation – Goalson is the only PET reclaimer currently located in Northern California, with a facility in Oakland. Goalson has been operating for over ten years, recycling a variety of pre- and post-consumer plastics. Goalson received a DOC grant to install PET washing capacity, but permitting and siting issues have delayed implementation. Goalson is reportedly washing and flaking a limited amount of PET, but shipping it to China, due to quality issues.

Guangyi Group – Guangyi Group, located in Long Beach, sorts and grinds PET for export to China as dirty flake. Guangyi Group exports directly to a fiber mill in Ningbo, China. The mill produces fiber for the automotive, toy, and clothing industries in China. The company currently exports 40 to 50 million pounds per year of dirty PET flake. They would like to expand to washing, but would likely need to relocate from their current facility in order to add washing capacity.

Table 4-1, left, provides the national end-use markets for recycled PET in 2007, by percent. Because of California's large agricultural markets, and the growing popularity of PET clamshell containers for produce and other foods, California's end-use markets for recycled PET are primarily limited to sheet and/or food containers. There are at least nine companies in California with combined PET extrusion capacity to produce over 500 million pounds of sheet and/or thermoformed containers. However, only two companies, Peninsula Packaging and Leading Industries (dba Pinnacle Plastic Containers), purchase the majority of recycled PET flake sold in the State.

Peninsula Packaging – located in Exeter, Peninsula Packaging produces thermoformed containers, with an average of 25 to 50 percent recycled content. The company, in operation for ten years, has 100 million pounds of PET thermoforming capacity. They purchase recycled PET from California, but must also purchase imported flake to meet their capacity needs.

Leading Industries (dba Pinnacle Plastic Containers) – located in Oxnard, Leading Industries also produces thermoform PET containers. The company has been in business for over 25 years, but has been utilizing PET since 2002. Leading Industries received a DOC grant in 2007 to install a new extrusion line that would allow them to increase their use of recycled PET.

Other extrusion/thermoforming companies that have, or potentially could, utilize recycled PET include: PWP, Pactiv, FDS Manufacturing, Packaging Plus, Global Plastics (the sheet production arm of Global PET), Sabert, and Winplast. Thermoformers also utilize virgin PET, as well as off-specification and

post-industrial PET. Reportedly, Clear Lam Packaging, based in Illinois, is opening a $4 million extrusion and thermoforming facility in California that will utilize recycled PET and PLA. In order to meet their demand for recycled PET, some thermoformers purchase imported recycled PET flake and/or sheet from Mexico, Canada, and Taiwan.

During 2007, and the first three quarters of 2008, the DOR's Market Development Payment (MDP) program helped support California's PET (and HDPE) reclaimers and end-users. MDPs were established by AB 3056 to develop California markets for recycled empty plastic beverage containers. The $5 million in annual MDP funding ran out in the fourth quarter of 2008, and the program was suspended in 2009 due to DOR budget constraints. Taking into account non-CRV PET, the effective MDP for PET was 7 cents per pound, 3.5 cents per pound to the reclaimer, and 3.5 cents per pound to the end-user, for every pound of California CRV PET flake. MDPs were effective in helping California reclaimers compete against China to purchase bales, and in encouraging California thermoformers to purchase California recycled PET flake, rather than flake from Taiwan, Canada, or Mexico.

A portion of California's recycled PET does go into the fiber market, as carpet. The primary domestic (non-California) purchasers of California are located in the Southeast. Historically, non-California PET reclaimers have purchased approximately 40 million pounds per year of California recycled PET bales, paying the higher price and freight costs (about 6 cents per pound), because California provides a consistent source of high quality PET. As competition between domestic reclaimers increases, there may be less California recycled PET going into carpet, and more going into other end-uses.

There are also a number of companies that are in various stages of entering the recycled PET market. However, between the weak economy, volatile markets, and the DOR's budget uncertainty, there is less enthusiasm for entering California's recycled PET market today than there has been in recent years. We briefly describe six companies, and their current level of interest in California PET reclaiming (or end-use), below.

Peninsula Plastics Recycling – is a joint venture of Merlin Plastics of Canada, and Peninsula Packaging. Peninsula Plastics was awarded a DOC grant to help finance a PET reclaiming facility in the Central Valley. The company plans to utilize 62.5 million pounds of recycled PET bales to produce 50 million pounds of recycled PET flake and pellets. Once the company is in full operation, they will sell one-half of the recycled PET to Peninsula Packaging for thermoformed packaging, and will produce bottle-grade recycled PET for the remainder of their output. Potential end-users for the bottle-grade recycled PET include Ball Corporation, Liquid Container LP, Signode, Pactiv, PepsiCo, and Graham Packaging. The facility would utilize Merlin's proprietary washing technology.

PET LLC – this planned 60 million pound per year PET bottle-to-bottle recycling facility in Modesto is on permanent hold. The plan was for a first-class operation to go from bales to bottle-grade recycled resin, addressing the demand for high quality bottle grade recycled content. However, PET LLC was in the midst of obtaining the last required funding when the economy tumbled last fall. Between the banking crisis, the general weak economic climate, and the specific financial crisis in California, the company was not able to obtain financing. If this project does moves forward, it is possible that the facility would be sited outside-of-California.

New Earth Systems – this is a new company, located in Canoga Park, that utilizes a solvent and water system to wash and flake recycled PET bales. This company has reportedly had technical and financial issues, and in early 2009 was not

purchasing any PET. If successful, New Earth Systems could utilize between 20 and 40 million pounds of recycled PET bales.

Allan Company – Allan Company operates one of the State's largest networks of recycling and processing facilities. Allan Company was awarded two DOC grants to develop recycled PET washing, flaking, and sheet production capacity at a facility in Pomona, but was unable to utilize the funds. Allan Company is still evaluating potential options to establish PET reclaiming at the Pomona location, without grant funding. Allan Company has ready access to recycled PET feedstock through their recycling and processing centers.

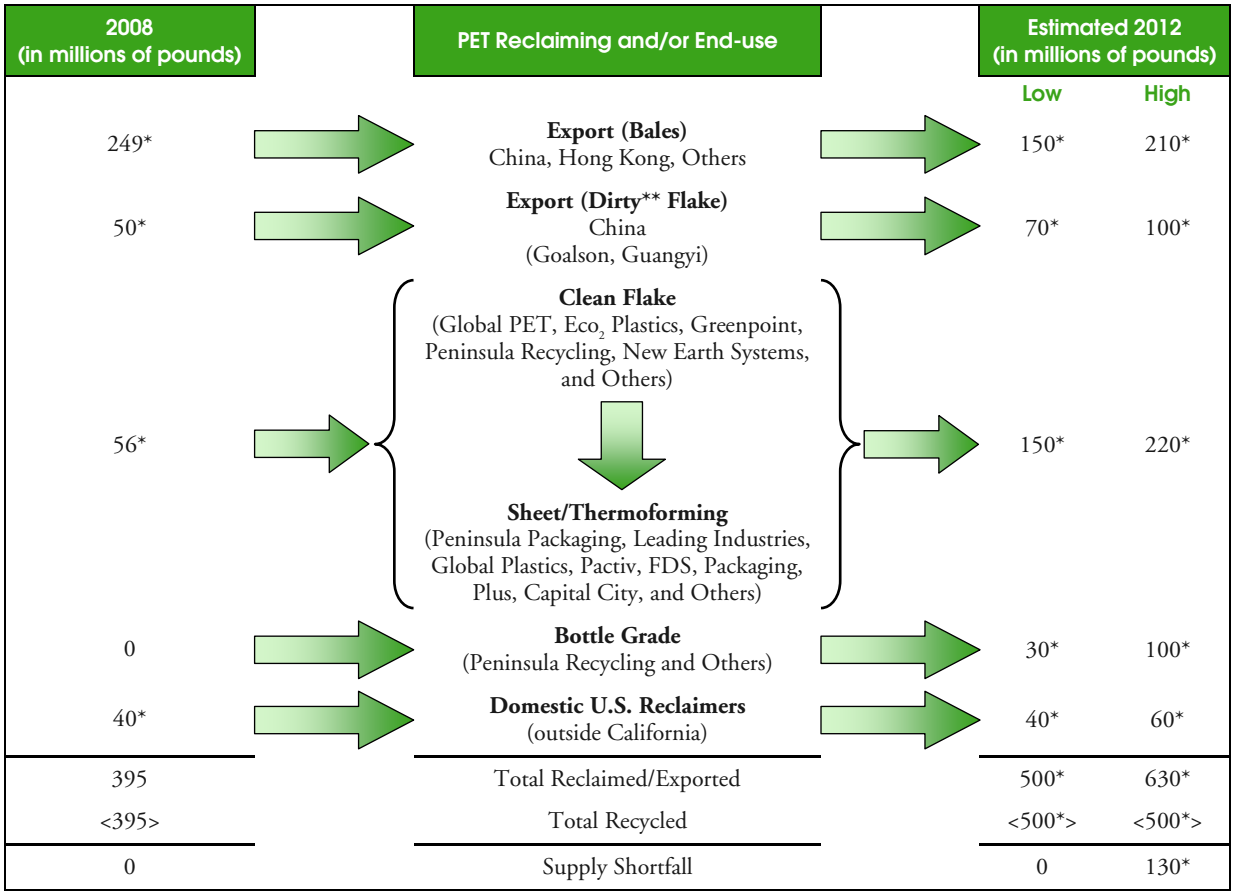
Capital City Packaging – Capital City Packaging is a potential start-up company affiliated with Ming's Recycling in Sacramento. Ming's is a recycler/processor that handles a significant amount of PET. Capital City received a DOC grant in 2007 to establish an extrusion/thermoforming facility. Capital City Packaging would not create new reclaiming capacity, but would utilize washed flake produced by Global PET and ECO_2 to produce recycled PET sheet for thermoforming into fruit baskets and other retail packaging. Capacity would eventually reach over 10 million pounds, resulting in an additional end-market for recycled PET flake. Capital City Packaging was another victim of the economic downturn; they were in the midst of finalizing financing for the project when the markets "crashed". Since the initial financing was never realized, Capital City is currently seeking new investors in order to reactivate the project.

PTP Group Americas – PTP utilizes a unique process to produce bottle-to-bottle grade recycled PET. The process, operating in Europe, involves modifying the recycled PET by adding a silicone molecule, thus producing PET-M. PTP has tested PET-M, and claims it is 100 percent recyclable with virgin and/or solid-state recycled PET. The company is seeking to establish a bottle-to-bottle facility in California. Their system has lower energy requirements than traditional bottle-to-bottle processing, and is cost-competitive with virgin PET.

Entrance of any of these companies into California's recycled PET market will result in shifting of material from current end-markets. In mid-2009, there was a reasonable balance between supply and demand for recycled PET, including exports to China. There is room for additional recycled PET reclaiming in California, although at some point there will likely be a shortage of recycled PET required to meet the needs of both China and future in-State reclaiming. One source of supply is increased recycling; in 2008 there were 225 million pounds of CRV PET not recycled in California.

Figure 4-3, on the next page, compares California's 2008 recycled PET end-markets with projected low, and high, 2012 recycled PET end-markets. The 2012 scenario assumes that the quantity of PET recycled will increase to 500 million pounds by 2012 (an approximately 80 to 85 percent recycling rate, depending on sales levels). The low assumption assumes that exports to China will decrease somewhat, while the high assumption assumes that exports to China will decrease more substantially. Both the low and high estimates are based on significant increases in California PET reclaiming and end-use, however; the low 2012 estimate is based on more conservative assumptions about the ability of current and potential PET end-user's to enter the recycled PET marketplace. The high 2012 estimate is based on more optimistic assumptions on the success of current and potential PET end-users. Under the low estimate scenario, the supply and demand for recycled PET will be balanced. Under the high estimate scenario, if all potential market players add capacity, there will be a supply shortfall of 130 million pounds. Given the difficulty in establishing new PET reclaiming capacity in California, it is unlikely that the high estimate scenario will be realized.

Figure 4-3
Comparison of 2008 PET, and Low and High Estimates for 2012 PET Reclaiming Capacity



*Estimated quantities
**Includes some clean flake

B. Current Market Dynamics

The price of recycled PET bales in California and Nevada went from an average of 30 cents per pound in August 2008, to 5.5 cents per pound in November 2008. From mid-September 2008 to mid-October 2008, the average bale price dropped by nine cents per pound (-35 percent), and then dropped another 10.5 cents per pound (-62 percent), by mid-November 2008. Recycled PET prices began to increase in mid-January 2009, but were still below the five-year historical average of 20.5 cents per pound in late May 2009.

The drop in PET bale prices in late 2008 was in large part the result of a near shut-down in exports to China, due to the general economic downturn and the failure of credit markets. A number of small export brokers in California, and one reclaimer (AE-Way), went bankrupt during this time.

There have not only been challenges with PET prices, but also with payments. For large volumes of high quality bales, sellers may request payment up-front. However, bales and recycled flake are often sold on credit. Standard payment terms used to be 15 to 30 days. In mid-2009, it typically took 45 days to get paid, and often as many as 60 days. In addition, banks are simply not loaning money. This creates cash flow problems for recyclers, processors, and reclaimers. It also creates a significant amount of uncertainty in the marketplace, which is amplified by the

economy and DOC's budget issues. Will customers stay in business in order to pay their bills? Will China remain in the marketplace? Did prices hit bottom last fall in 2008, or will they crash again? Will the DOC be making payments for grants and MDPs?

There are several wide-ranging factors currently affecting recycled PET markets. Below, we discuss eight factors: (1) challenges related to PET reclaiming capacity; (2) increasing vertical integration of PET reclaiming and end-use; (3) volatile recycled and virgin PET pricing; (4) high volumes of PET exports to China; (5) declining virgin PET sales; (6) quality of PET bales; and (7) barriers and additives in PET bottles; and (8) demand for PET recycled content.

In the box on the next page, we describe, in general terms, how a number of these interrelated factors influence plastic reclaiming.

1. Challenges Related to PET Reclaiming Capacity

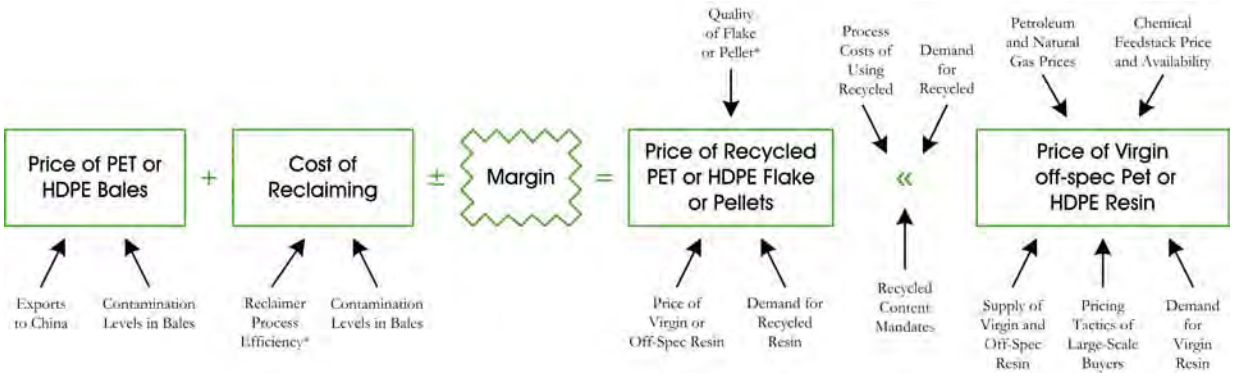
The United States PET reclaiming facilities only have capacity to process 60 percent of the PET that is collected. There are a number of announced capacity expansions or new facilities for PET reclaiming in the United States, primarily in the eastern half of the country. Most of the expansions are for vertically integrated production (i.e. capacity used directly by the reclaimer in their end-product), as opposed to merchant reclaiming (i.e. sold on the open market). Much of the new merchant recycled PET capacity is for incremental increases by existing reclaimers. For example, Phoenix Technologies, in Ohio, is expanding their 80 million pounds per year recycled flake capacity with a new 10 million pound per year food-grade recycled PET line. The company uses a proprietary technology to convert flake into pellets without extrusion, instead compacting a fine powder into pellets. Eventually, Phoenix Technologies would like to license their technology.

New United Resource Recovery Corp LLC (NURRC) and Coca Cola are opening a joint-venture PET bottle-to-bottle reclaiming facility in South Carolina. The $45 million facility will eventually have approximately 100 million pounds of capacity, with one approximately 50 million pound line opening in 2009, and one in 2010. NURRC's Hybrid unPET technology chemically cleans PET flake, reducing operating energy and water costs. There is some uncertainty surrounding the new plant, and many existing reclaimers are unwilling to invest in new capacity until they see how the NURRC facility affects the marketplace. Coke will purchase just over one-half of the output, and NURRC will seek to sell the remaining output to Southeastern Container Inc., Graham Packaging, and Amcor PET Packaging.

Wellman, one of the first companies to conduct PET reclaiming, is under new ownership, and plans on reopening part of its' PET bottle recycling operation in South Carolina by the end of 2009. The facility has capacity to process 190 million pounds of recycled PET per year. Wellman Engineering Resins CEO Robert Fotsch commented that recycling "presents a good business opportunity for the next five to ten years. Oil is a scarce resource, and the price is going to continue to go up over time, even with the economy in a downturn. Over the long-term, the price of oil will go up because of supply and demand, so we as a country and a world need to get serious about oil derivative-type products. Whether it's carpet or bottles or whatever, we need to take it and re-use it. There will be times when [recycling] will not be as economical, but over time it will be a good business" (Plastics News, April 13, 2009, p.9).

Three other companies planning on new PET reclaiming capacity include: PWP Packaging, based in Vernon, California; Custom Polymers PET LLC in Alabama; and Clear Path LLC in North Carolina. PWP will open a facility in West Virginia to initially produce 40 million pounds (and eventually

Factors Impacting the Economics of Plastic Reclaiming



Plastic reclaimers purchase bales, clean and process used plastic containers into flake or pellets, and sell the flake or pellets to end-users. A key problem with recycled plastic (PET and HDPE) reclaiming in California is that there is a significant disconnect between the factors that influence the price of raw material (bales), and the factors that influence the price of end-product (recycled flake or pellets).

In California, the price of bales is determined, for the most part, by the price that Chinese importers are willing to pay. This price depends on the strength of Chinese demand, availability of cheap shipping to Asia, the level of enforcement of Chinese restrictions on whole bottle imports, and Chinese government subsidies. For the most part, if California reclaimers want to purchase bales, they must meet whatever price the export market sets.

The export market price has essentially no relationship to the price of virgin resin. The recycled flake or pellets are substitutes for virgin or off-specification (off-spec) resin. (Off-spec resin is essentially low-grade virgin resin.) Thus, the price that reclaimers can sell recycled flake or pellets to end-users must be lower than the price of virgin or off-spec, including the price of any imported resin. For many price-sensitive end-users, off-spec is typically a direct substitute for recycled. Thus, it is often the price and supply of off-spec that determines the price at which reclaimers can sell recycled resin. Recycled resin must be enough less than virgin or off-spec to make up for perceived or real differences in quality, flow-through, or other reduced operating efficiencies that result from using recycled resin. Increasingly, end-users may seek out recycled resin to reduce their environmental impact, but rarely will they pay more than virgin.

The figure above illustrates the margin equation for reclaimers. Whether the margin is positive or negative depends on the components of the basic equation. These values depend, in turn, on a number of other factors (shown with the arrows), most of which the reclaimer cannot control.

Reclaimers suffer when the margin between the price of bales and the price of their end-product does not cover their operating costs. There are at least a few ways to improve the margin: 1) reduce operating costs by improving efficiency, 2) reduce the price paid for bales, and 3) produce a higher-value end-product that will fetch a higher price. The DOC has funded grant projects that help reduce operating costs by improving efficiency. The MDP was one mechanism to essentially subsidize, by a few cents, the price of bales and/or recycled flake or pellets. The shift toward vertical integration of reclaimers, and production of food-grade or higher-end products addresses the third mechanism. The DOC has also funded grant projects for this third approach to improving the margin.

It might seem that reclaimers would have been in a strong position to purchase low-cost bales when the market "crashed" in late 2008. However, there was a relatively short window in which reclaimers were able to purchase bales. There were two opposing factors at play in the market. First, recyclers and processors were storing the material, waiting for the price to increase. In addition, virgin resin prices had dropped, reducing the demand for recycled resins. Reclaimers were able to purchase some low cost recycled plastic bales, but not significant quantities. As one reclaimer noted, it was difficult for companies to develop and implement a business strategy when there were such dramatic changes in the marketplace.

* These are the two factors for which the reclaimer has primary control.

60 million pounds) of food grade recycled PET for thermoformed trays, clamshells, and other containers. They will use most of the output at a nearby PWP thermoforming operation. Custom Polymers is expanding from 50 million pounds of recycled PET to 75 million pounds.

Clear Path LLC, along with carpet maker Shaw Industries Group, and fiber company DAK Americas LLC, will begin construction of a 280 million pounds per year PET recycling facility in North Carolina. They expect to have the first 140 million pounds of capacity on-line in March 2010. This facility hopes to obtain recycled PET available due to North Carolina's ban on landfilling PET, which goes into effect in October 2009. Only 25 percent of the output will be sold on the open market, the rest will be used internally. Echoing the comments of Wellman's CEO, Tom Sherlock of DAK said, "this is market driven. There is a greater social consciousness on the part of consumers, and the American people have a strong preference for material that is friendly to the environment. We needed to step up our sustainability efforts and lower our carbon footprint, so we decided to become active in the recycling community and take an active role in becoming sustainable" (Plastics News, May 25, 2009, p.14).

Despite these new developments relating to PET reclaiming capacity, there has been very little new merchant PET reclaiming capacity built in the United States. As one industry analyst explained, if you were a bank, would you loan money for a start-up operation for which: (1) the price of the feedstock supply (PET bales) is inelastic, and there is basically a guarantee that prices will be high; (2) the quality of the supply is highly variable, and low – bottle resin innovations result in new additives, barriers, and resin blends, that contaminate loads and increase processing costs; (3) the company's end product must be the same quality as virgin resin, but at a lower price; and (4) the company's customers are not willing to make concrete commitments to purchase the recycled flake or pellets end-product? Even in good economic times, these four operating conditions are extremely challenging. The slow progress in developing California PET reclaiming, even with the support of DOC grants, reflects these difficulties.

One development that improves the financing potential for PET reclaimers is implementation of new or expanded bottle bills. It is much easier for a reclaimer to obtain financing when there is a bottle bill state nearby. Many of the recent East Coast PET reclaiming expansions are likely in response to bottle bill activity. New York and Connecticut recently passed bottle bill expansions (to include bottled water), and there is potential for expansion in Massachusetts, and perhaps a new bottle bill coming in Tennessee.

2. Increasing Vertical Integration of PET Reclaiming and End-Use

In what appears to be a response to uncertainty in the marketplace, companies at all levels of the recycled PET value chain are increasingly seeking to vertically integrate. Recyclers and processors are looking to add as much value as possible to the material they collect by adding reclaiming capacity. They are also looking to have more control over end-use markets. If recyclers have a captive market for their bales, they don't have to worry about China, from either the demand/price side of the equation, or concern about China's lax environmental practices. Also, since recyclers control the quality of bales, if recyclers do the reclaiming themselves, they do not have to worry about rejected loads and price reductions. Two of California's largest recycling/processing companies, Tomra Pacific and Allan Company, are considering vertical integration to add reclaiming capacity.

Reclaimers are also seeking to vertically integrate by building in end-use capacity. Global PET is a prime example – expanding from washed PET flake,

to sheet, to thermoforming. Vertical integration at the reclaimer level helps reduce the uncertainty about end-markets. For example, if thermoformers stop buying recycled flake, Global PET can produce their own sheet, and/or thermoformed product. Peninsula Recycling, the proposed joint venture between Peninsula Packaging and Merlin Plastics, is another example of vertical integration at the reclaimer/end-user level.

Recycled PET end-users are also expanding vertically to develop PET reclaiming capacity. End-users want to ensure that they have a reliable source of recycled PET. As noted above, most of the new PET reclaiming capacity being built across the country is for internal use. Much of the capacity from the NURRC facility in South Carolina will go directly to Coca Cola. The large thermoformer PWP is building their own PET reclaiming capacity to support their packaging lines. The Clear Path LLC facility in North Carolina will support their partners' PET fiber use. These end-users are looking to ensure a steady supply of recycled material.

The result of all this vertical integration is that it may become increasingly difficult for those that aren't vertically integrated to participate in the recycled PET marketplace. There will be fewer recyclers/processors selling bales on the open market; fewer reclaimers selling recycled flake; and fewer end-users purchasing recycled flake.

3. Volatile Recycled and Virgin PET Pricing

When the price of virgin resin is low, it is very difficult for end-users such as thermoformers to justify purchasing recycled PET, because price and quality are major concerns. The price of virgin PET fell from 85 cents, to 56 cents, per pound during the fall of 2008. The price was back up to 65 cents per pound in December 2008, but analysts expect that it may remain low – 62 to 65 cents per pound – through 2009. Virgin PET pricing rarely drops below 60 cents per pound, but on the occasion that it does, it is likely that virgin PET will be lower than recycled PET.

Figure 4-4, on the next page, provides average annual scrap prices, paid by processors to recyclers in California, for PET. These are prices utilized by the DOR to determine processing payments and processing fees. PET scrap prices reached all-time highs during 2008. These annual figures do not reflect the extreme price volatility of the last year.

Figure 4-5, also on the next page, provides the average monthly scrap prices, paid by processors to recyclers in the State. Figure 4-5 illustrates the dramatic drop in scrap prices in Fall 2008, followed by the gradual recovery. In 2009, the price of PET bales has been fluctuating between 15 and 20 cents per pound – it will not likely go to the highs of last summer (unless gas prices go up again). If prices for virgin PET in China increase, then the Chinese can afford to pay more for PET bales, driving the California bale price up, and giving China more purchasing power.

Figure 4-6, on page 4-13, illustrates the price differential between PET bales in California and Nevada, and nationally. Since Fall 2006, California/Nevada average bale prices have been several cents per pound above national averages. There are two reasons: first, the Chinese export market dominates pricing on the West Coast, and second, the Beverage Recycling Program results in higher quality PET bales than most of the rest of the country.

Figure 4-7, on page 4-14, provides a comparison of virgin PET, clear recycled PET flake, clear recycled PET pellets, and PET bales. Figure 4-7 illustrates the linkages between these various forms of PET. We should note that the PET bottle resin prices in Figure 4-7 are actually higher than true market prices, because they do not include prices paid by the large-scale PET buyers.

Figure 4-4
PET Average Scrap Values (1999 to 2008)

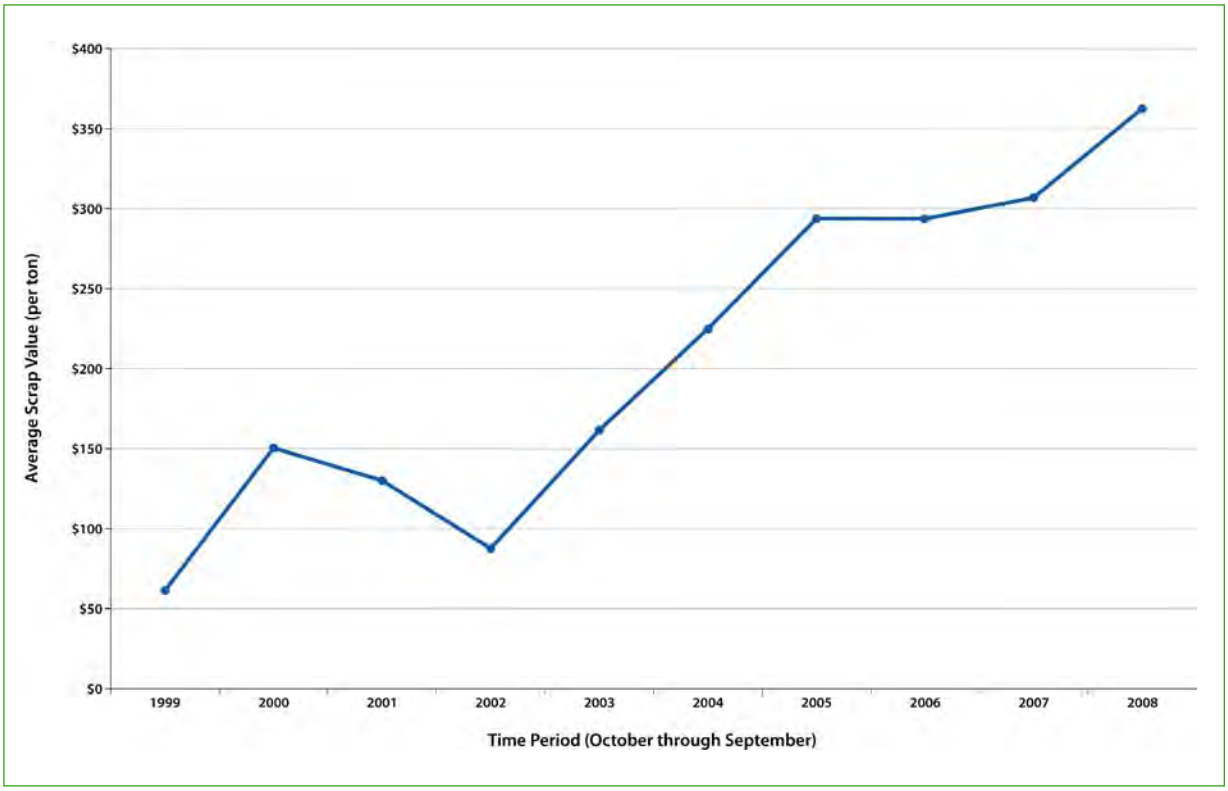


Figure 4-5
PET Average Scrap Values by Month (February 2008 to February 2009)

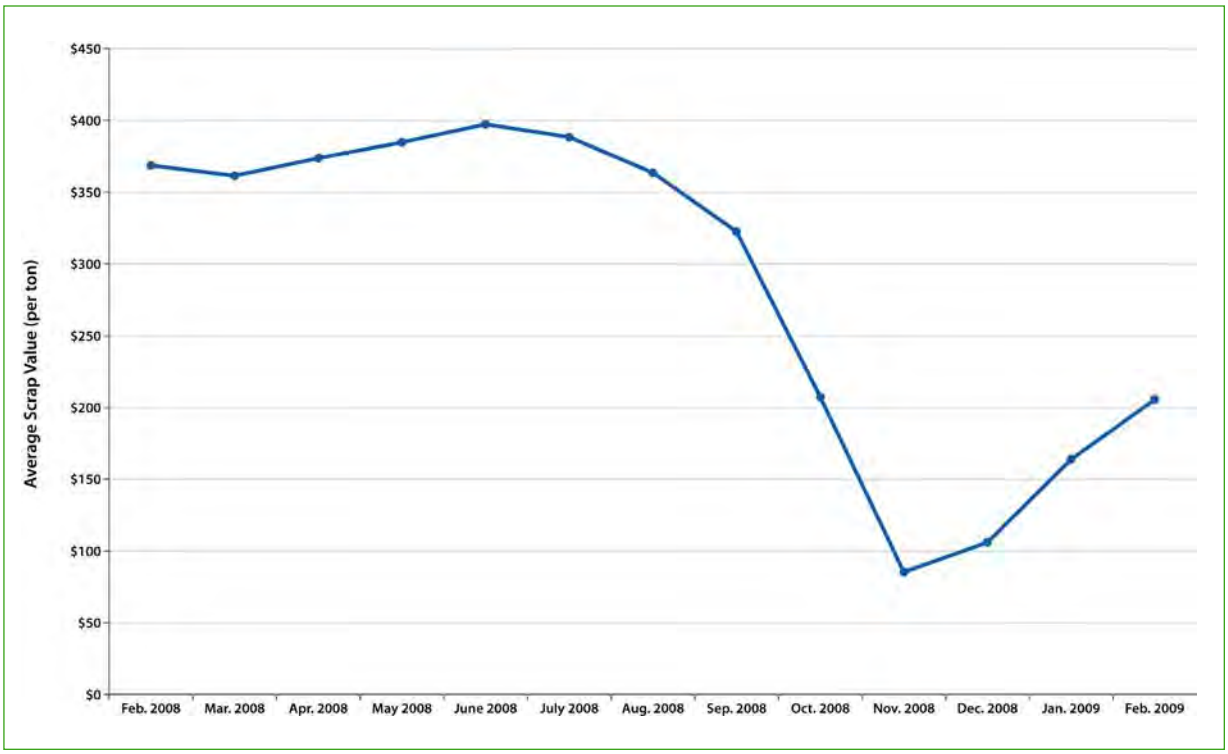
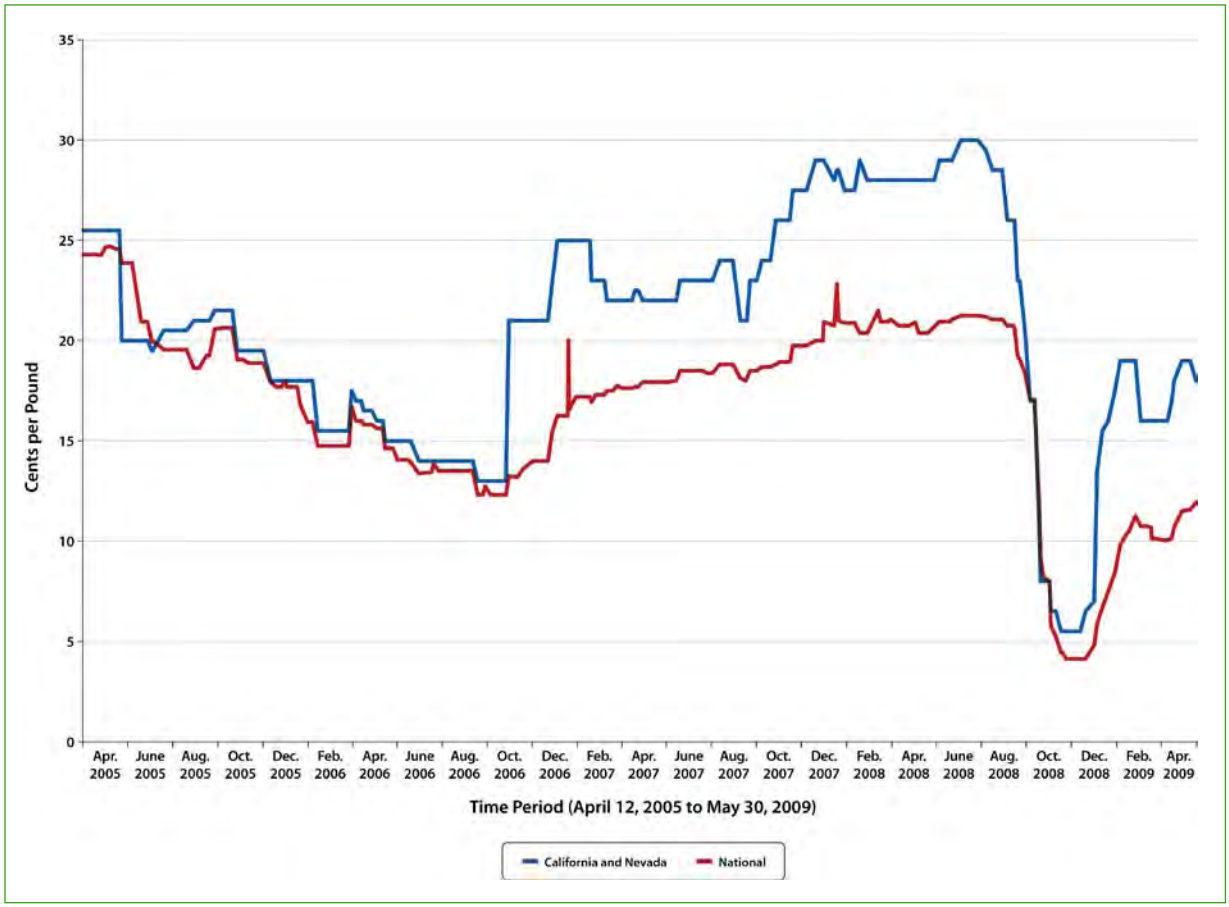


Figure 4-6
Comparison of PET Bale Prices (Picked Up) – California and Nevada vs. National (April 12, 2005 to May 30, 2009)



Source: Waste and Recycling News, Commodity Pricing.

Complicating the entire pricing system is the fact that in reality, manufacturers never know the price of virgin PET until 90 days, or more, after the fact. Published prices for PET typically do not reflect what is actually going on in the marketplace. The price of PET is determined by the largest buyers – PepsiCo and Coca Cola Company. These companies utilize the "Wal-Mart model" of pricing. Essentially large buyers have enough leverage to go back to their suppliers after the fact, and change the price. For example, the supplier might have sold resin for 60 cents per pound in May, but in July, the purchaser comes back to them and says, "I'll actually only pay you 58 cents a pound for what I purchased in May, and I'll subtract that 2 cents per pound from your July invoice." This pricing practice has implications for recycled resin, because purchasers don't really know what the margin between virgin and recycled is at any point in time. If the price of virgin was "reduced" after the fact, it may result in a situation in which recycled resin costs more than virgin.

Concerns about the price point are the primary reason implementation of additional new PET reclaiming in California has been so slow, according to several industry stakeholders. PET reclaimers cannot afford to operate for more than a short time if the price of virgin PET drops below

Figure 4-7
Comparison of Various PET Prices (April 11, 2008 to May 30, 2009)

Source: Waste and Recycling News, Commodity Pricing and Plastics News, Resin Pricing.

the price of recycled. Since there are time lags in pricing changes, and the price of virgin is often not known until after the fact, the chance that virgin prices drop below recycled prices is high.

4. High Volumes of PET Exports to China

Approximately 70 percent of the PET generated in California is exported, primarily to China and Hong Kong. Nationally, the percent of PET exported is lower, but still substantial. In 2007, U.S. reclaimers purchased 641.5 million pounds of recycled PET, and exporters purchased 755 million pounds, 54 percent of the total. In 2002, China purchased only 275 million pounds, or 34 percent of the total. There are many interrelated effects, discussed in this subsection, resulting from the high export levels, such as impacts on quality, reclaiming capacity, and pricing.

Mike Schedler of the National Association for PET Container Resources (NAPCOR) believes that exports to China are resulting in less new reclaiming in the United States, "The Chinese pattern of buying more and more of the materials collected couldn't help but have a long-term negative impact. We are seeing the fallout today. The Chinese buying the last three to four years has greatly inhibited and put a damper on reinvestment. We didn't see any significant investment in reclaiming capacity – particularly in

merchant reclaiming capacity, even though the last three years were the industry's most profitable years ever" (Plastics News, December 8, 2008, p.4).

China has invested in PET reclaiming capacity. Much of the recycled PET that is exported to China makes its way back to California, in the form of clean washed flake, sheet, or end-products. Currently, most PET recycled in China is utilized in fiber, a relatively low value end-use. However, Chinese companies are investing in bottle-to-bottle recycling in China.

Beijing Incom Resources Recovery Company is purchasing German equipment to produce bottle-grade pellets, and plans on processing 110 million pounds of bottle-grade PET per year. The company eventually plans to build five more PET bottle-to-bottle facilities, each with 66 million pounds of resin capacity. While China recycled 75 percent of their own PET containers, given these investments in PET reclaiming, it appears that China will be importing PET well into the future. However, it is difficult to predict China's future level of interest in California PET.

There is concern that if China stops buying, even temporarily, there will be a significant volume of recycled PET with no end-markets. This happened temporarily in November 2008, when California's PET markets essentially shut down. China is currently not as aggressive in purchasing recycled PET, because the fiber market, where most of the PET exported to China is used, has been hit hard by the economic downturn.

Historically, shipping recycled PET to China has cost less than shipping recycled PET across the United States. This was because there were a large number of empty container ships waiting in California ports to return to China. Today, imports from China are down drastically, along with international trade in general. As part of their economic stimulus, China has reduced or eliminated the $3,000 to $4,000 per shipping container quota (or tariff) that they previously charged. Without this additional fee, in Spring 2009, it cost only $75 per 42,000 pound container load, to ship recycled plastic to Hong Kong. This is only 0.18 cents per pound – a shipping rate that is very difficult to compete with.

The fact that China is a dominant player in California's recycled materials markets also has positive implications. California is essentially an extension of the Pacific Rim. Export of significant portions of California plastic (and paper) to China creates somewhat of a paradox. On the one hand, the presence of the Chinese export markets keeps prices relatively high, and recycled material markets strong. Between California's strong waste management and recycling laws, and the ready-availability of Chinese markets, there is little chance that recycled materials in California will be sent to the landfill, as can occur in some parts of the country. When there is a healthy balance between exports and domestic use, the recycling system is strong, and all players benefit. The difficult aspect comes in defining, and maintaining, a "healthy balance". Most in the industry would agree that California should have viable alternatives to utilize materials in-state, and that export should not completely dominate recycled material markets.

5. Declining Virgin PET Sales

The virgin PET resin market is overbuilt. In addition, there are planned capacity expansions in 2009 of almost 4 billion pounds of virgin PET combined, by Eastman, Indorama Polymers, and M&G Group. Much of this new capacity was planned several years ago, when bottled water was experiencing double-digit growth, soft drink sales were still increasing, and the economy was strong.

Since late 2008, there has been a multi-point assault on virgin PET resin. First, the economic downturn has resulted in lower beverage sales in general. Second, for health reasons, carbonated soft drink sales continue to decline. Third, there

has been a bottled-water backlash, with increasing consumer concerns about wastefulness of single-serve water bottles. Bottled water sales declined in 2008 for the first time ever. Fourth, the health risk concerns about the additive bisphenol-A (BPA), in plastic bottles in general, have affected PET. Fifth, light-weighting has contributed to reduced PET resin sales. Nestlé Waters light-weighting of their 500 ml water bottles reduced annual PET use by 140 million pounds. PepsiCo and Coca Cola have also announced light-weighting that will result in similar reductions in PET use. In addition, the industry may have underestimated the impacts of all these factors, resulting in unrealistic projections about growth in PET sales. PET virgin resin sales declined in 2008, and will likely decline further in 2009. Eastman's Performance Polymers, which primarily produces PET virgin resin, had a $25 million operating loss in the first quarter of 2009.

One analyst noted that it is likely that there will be shut-downs and consolidations in the virgin PET industry over the next year. The poor condition of the industry results in short-term bad decisions by companies. Resin manufacturers are worried about the next month, and not the bigger picture. Companies have not invested in R&D, and are cutting staff. Because production is up, but bottle resin sales are down, companies are also relying more heavily on exports.

Industry experts do not expect the petrochemical market, which includes the PET industry, to recover until at least 2011. Gary Adams, president of Chemical Market Associates, Inc. (CMAI) believes that the petrochemical market will have surplus capacity until 2011, which will require plants to shut down in order to rebalance supply and demand. Adams stated, "capacity and demand growth are out of sync because of the recession, so higher-cost capacity will have to close in the U.S., Western Europe, and northeast Asia. These closures will be critical to the industry's recovery in 2012 and 2013" (Plastics News, April 13, 2009, p.1).

Typically, excess virgin capacity pushes virgin PET prices down, reducing the margin for recycled PET. There are exceptions to this normal supply/demand dynamic when gasoline or other PET feedstock prices are high. In that case, PET prices stay high, even when demand is low. This was the case in the summer of 2008.

Because the virgin and recycled PET industries are so entwined, the poor shape of the virgin industry impacts the entire recycling system. There is excess virgin PET capacity, resulting in lower prices, and reduced margins for recycled PET. In addition, resin manufacturers turn to low-cost alternatives that negatively impact recycling, such as increased use of additives.

6. Quality of PET Bales

Because of the Beverage Recycling Program, California's PET bales are higher quality than most parts of the country. Combined with the strong Chinese export market in California, these factors lead to a higher PET bale price in California, as compared to much of the nation.

However, the strong export market acts to drive quality down. Chinese buyers will pay top price for PET bales, even if they are highly contaminated. One of China's competitive advantages, as it relates to recycling, is manpower for sorting. China can afford to sort contaminated bales. For a reclaimer located in the United States, manual sorting increases costs, reduces throughput, and reduces yield. With prices driven up by exports, reclaimers end up paying more, and getting less. There is no incentive for recyclers, particularly curbside programs, to provide high quality bales. From the recycler's perspective, economics favor export of low quality bales. Bales from buyback centers are variable, but generally of higher quality. Curbside bales are typically not high quality, even with the DOR's Quality Incentive Payment (QIP) program. One reclaimer commented, they would "rather take

buyback plastic all day, before they touched curbside." There is even interest among reclaimers in investing in sorting equipment at the MRF in order to improve the quality of PET curbside bales.

7. Barriers and Additives in PET Bottles

Manufacturers utilize barriers and additives in order to change the characteristics of the bottles. Resin manufacturers look at barriers as a way to move into new markets, for example teas, juices, beer, and energy drinks. The Association of Post Consumer Plastic Recyclers (APR) conducts ongoing monitoring of additives which may be included in PET, HDPE, and PP bottles, and polyethylene films, to determine the impact of additives on recycling. There are approximately 40 different polymers that are used as barriers or additives in PET. Some in the industry believe that barriers and additives, intentionally added by the virgin resin manufacturers, are as great, or more, of a problem than external contaminants in the recycling stream. Resin manufacturers, especially in this economic climate, are not concerned about the impact of additives on recycling streams.

The increased use of barriers and additives in PET bottles is a growing problem for PET recycling. Optical sorting can only identify a limited number of different bottle types at a time. A major concern is that barriers are constantly changing; the barriers that are found in bottles one week, may be different than the ones that are found the following week. Reclaimers have resorted to manually sorting PET beverage containers that typically use barriers, such as juice; a procedure that adds significantly to their operating costs.

Barriers such as UV inhibitors, acetaldehyde scavengers, and fast reheat resins, impact the behavior of recycled flake, causing yellowing in thermoformed containers. To the extent that containers with barriers can be sorted out of the process before they are flaked, they represent a yield loss. In some cases, a significant percentage of the bale must be removed because of barrier bottles. While acceptable barrier contamination levels are much higher than for non-PET contaminants such as PVC and aluminum, barrier bottles are also harder to identify and remove.

In early 2009, two different beverage/bottle manufacturers, Planet Green Water Bottle Corporation in British Columbia, and Enso Bottles LLC in Phoenix, announced the availability of degradable PET water bottles.[2] Reportedly, these bottles contain an additive that makes them degrade in a landfill within one to five years. However, neither company has provided laboratory data to substantiate their claims that the bottles do not negatively impact PET recycling or the shelf life of products made with recycled PET (that include the degradable resin).

As a result, the PET industry is concerned about these bottles, and particularly their impact on recycling. APR and NAPCOR issued a position statement on degradable additives use in bottles and films, expressing their concerns about biodegradable, oxo-degradable, or photodegradable additives, and inviting user's of these additives to provide test data. NAPCOR has asked brand owners and bottle makers to not use PET containers with degradable additives. Dennis Sabourin of NAPCOR said, "we want the people making claims about bottles with degradable additives to first substantiate and document their claims" that there is no adverse effect on recycling (Plastics News, June 1, 2009, p.1).

Another issue is that the concept of degradable PET is questionable. The potential advantage of degradable PET bottles is that they address the large percentage of PET bottles that end up in landfills. However, rather than produce bottles that may eventually degrade in a landfill, it might be better

[2] This is not the same as PLA bottles, discussed in Section 7.

policy to increase recycling. In addition, these bottles still utilize petrochemicals. Even for the plant-based biodegradable resin PLA, the preferred end-use, in terms of resource conservation, is recycling, not composting. As Mike Schedler of NAPCOR commented, "… degradables [PET bottles] don't make anything green or sustainable. They just address bad human behavior. The larger issues are sustainability, climate change, greenhouse gas emissions, resource management and energy savings" (Plastics News, June 1, 2009, p.1).

8. Demand for PET Recycled Content

Demand for recycled content in thermoformed containers is at an all-time high. Driven in large part by retailers such as Wal-Mart and Whole Foods, there is first, a shift to PET from PVC and PS, and second, a strong interest in using recycled content for PET clamshells. There are also practical benefits to these containers. For example, even though clamshells are more expensive, Wal-Mart reportedly saved tens of millions of dollars in reduced product loss by replacing the traditional green plastic strawberry baskets with PET clamshells. One industry executive commented, "the market is changing rapidly because more companies are asking for recycled content for bottles, and because you have a whole category of thermoformers needing it for their food-packaging products such as clamshells, trays, and cups" (Plastics News, April 13, 2009, p.11).

For producers of recycled flake, it can be difficult to find buyers. Only two of California's nine major thermoformers are purchasing significant quantities of recycled flake in California. Reclaimers are concerned about being too reliant on so few customers. Thermoformers are reluctant to utilize recycled material if they haven't done so previously. The volatile recycling market and economic downturn may have scared away some potential users of recycled flake. On the other hand, the market for recycled content thermoformed containers seems to be high. Future producers of recycled content thermoformed containers are reportedly sold out before they are even in production.

Thermoformers do not just utilize recycled PET from California. They will also source material from Mexico, Taiwan, China, and Canada. Reportedly there is less recycled flake and sheet coming into California from China and Taiwan than there was a few years ago, but imported flake is still a competition issue for domestic reclaimers. Thermoforming has a very low margin, and companies will seek the lowest possible feedstock price. For many thermoformers, it doesn't matter whether they use recycled flake, or where that flake comes from. There are quality differences as well. Flake from Mexico is lower quality, and thus lower priced. Flake from Canada is equal or higher quality than California flake. Flake from Taiwan is mixed – always lower priced, and in some cases higher quality, because it is mixed with post-industrial plastic.

Thermoformers make purchasing decisions every day – should they buy recycled flake, or virgin resin? For some thermoformers, the MDP payment was an important factor in that decision, and one that encouraged those that might not otherwise purchase recycled resin to buy California recycled PET. Ed Byrne, of Peninsula Packaging commented, "if the cost of recycled resin is lower than virgin, that will drive demand because I don't think there are any players out there willing to pay more for virgin [in the thermoforming market]. Right now the price of virgin PET has put recycled PET at a disadvantage, but we think it is temporary" (Plastics News, April 6, 2009, p.9).

Recycled PET flake cannot just be substituted directly into thermoforming for virgin PET. Thermoformers must make some investments, such as crystallizing equipment, in order to process flake (as opposed to virgin pellets). Because flake is lighter, throughput is slower. In addition, the

increased level of contaminants in recycled flake means that the thermoforming line may need to be stopped in order clean equipment. In a big thermoforming company, if an employee makes a recommendation to invest in using recycled flake, and it doesn't work, the repercussion is likely job loss. Some thermoformers prefer to utilize post-industrial PET, which is cleaner, and thus less risky.

Just like glass container manufacturers, thermoformers say that they would use more recycled PET if they could obtain the quality of material they need, at a good price. The price differential between virgin PET and flake that thermoformers will accept varies. In spring 2009, the actual price differential was five cents. For some thermoformers, 5 cents per pound is an adequate spread between the price of virgin and recycled resin. Other thermoformers prefer a higher differential, such as nine to ten cents per pound (this was the differential for most of 2008). This is because even though recycled flake is less expensive, the total cost of operating with recycled flake is higher than with virgin resin. Other thermoformers would prefer a significantly higher differential of as much as 20 cents per pound.

While thermoformer demand for recycled PET is strong, one of the key issues with recycled content is the unwillingness of all but a few end-users to make solid commitments to purchasing recycled material. This is particularly true for bottle-to-bottle resin. Both Pepsi and Coke have targets of 10 percent recycled content. Pepsi is reportedly reaching that target, but Coke has only been at 3 percent. Dennis Sabourin of NAPCOR said, "end users of recycled content are unwilling to make long-term commitments [to purchasing recycled PET]" (Plastics News, December 8, 2008, p.4). This problem affects the ability of reclaimers to obtain financing. If end-users are not willing to make "bankable" commitments to purchasing recycled PET, reclaimers cannot obtain financing, especially in today's economic climate. One industry source commented, "recycled content sustainability initiatives go out the window when people can get bargains on virgin resin, at some point, if this industry is to survive, people have to take a long-term approach, commit to recycled content and leave some of these deals on virgin on the table" (Plastics News, December 8, 2008, p.4).

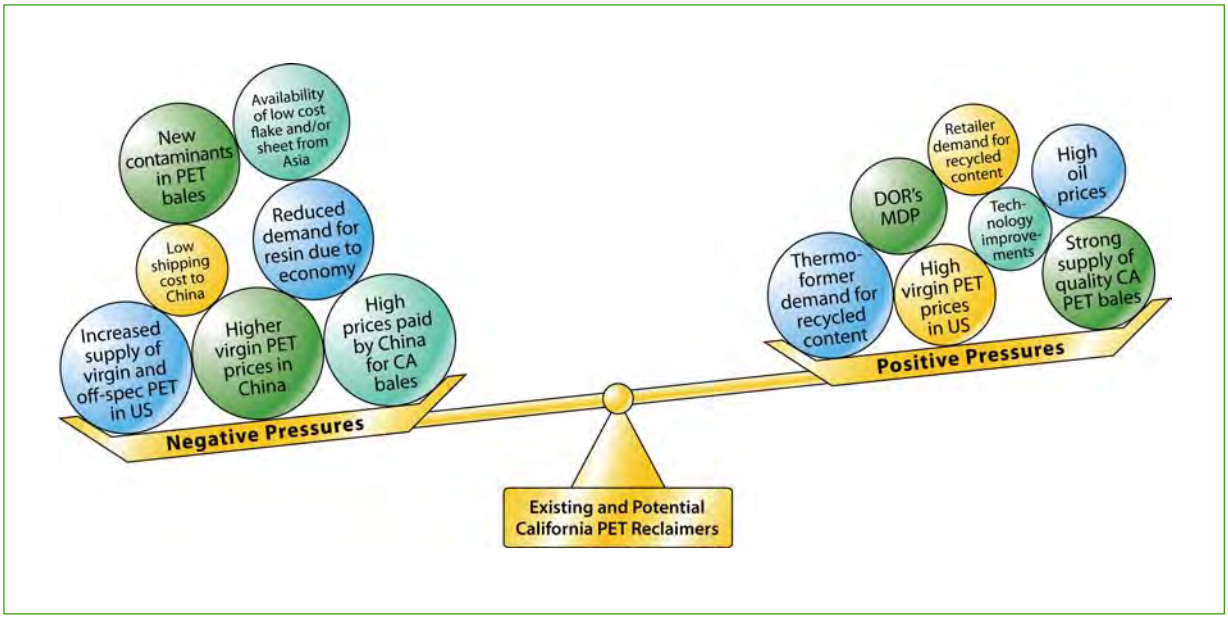
The California Integrated Waste Management Board's (CIWMB) Rigid Plastic Packaging Containers (RPPC) law requires most non-food plastic packaging containers sold within the State to: (1) be made from at least 25 percent postconsumer resin, (2) be source-reduced (light-weighted) by 10 percent, (3) be reused or refilled at least five times, or (4) achieve a 45 percent recycling rate if it is brand-specific or a particular type of RPPC. The RPPC law creates an incentive for product manufacturers to utilize recycled content, although it does not affect thermoformed food containers.

The RPPC law is extremely difficult to enforce, and as a result does not provide as strong an incentive as it could. The March 2009 *Plastic Recycling Update* reported that APR's executive director is meeting with the CIWMB to encourage enforcement of the law, stating, "the law is on the books, but isn't being enforced" (PRU, March 2009, p2).

C. Market Influences

Figure 4-8, on the next page, illustrates the market influences for PET. As these factors shift in significance, the dynamics change in favor of California (and other domestic) reclaimers, versus export. The factors on the positive side all act to increase the opportunity to use recycled PET in California, and to increase the incentive for additional PET reclaiming capacity in the State. The factors on the negative side all act to increase the incentives to export recycled PET. We discussed many of these factors above, as they relate to current market dynamics. Below, we discuss market influences that were not mentioned previously, and how they impact recycled PET markets.

Figure 4-8
Market Influences Affecting Existing and Potential California PET Reclaimers



1. DOR's Market Development Payment (MDP)

MDPs were established by AB 3056 to develop California markets for recycled empty plastic beverage containers. Taking into account non-CRV HDPE, the effective MDP was four cents per pound total – two cents to the reclaimer, and two cents to the end-user. MDPs were distributed in 2007, and for the first three quarters of 2008 (when the $5 million per year in funds ran out). In 2009, due to budget restrictions, the MDPs have been suspended for an unknown period.

Many long-time program stakeholders, including those that do not benefit from the MDP, expressed sentiments such as: "the MDP is the most effective program the DOR has ever done, by far." Some felt that MDPs were an important first step in helping California reclaimers compete with Asian markets, but not enough. By providing funds to California reclaimers and end-users, the MDP allows reclaimers to better compete with subsidized Asian buyers, and encourages end-users to utilize recycled content. With a few cents per pound payment, end-users are more willing to make the investments needed to utilize recycled flake. In general, the MDP strengthens the industry, helping existing companies and encouraging more companies to utilize recycled plastic.

One opinion that a number of industry stakeholders held was that the MDP is a fairer approach to support markets than grants. Many are concerned that grants are "hit or miss." Perceived problems with grants are that all the funds don't get utilized (when grant projects fail); that it is difficult for the DOR to pick the "winners and losers", i.e. which projects will be successful; that grants don't address market problems comprehensively; and that grants are "a beauty contest." With the MDP, all registered entities that sell or purchase reclaimed plastic are awarded. The issue of unfair competition is eliminated. To be fair, the Market Development and Expansion Grants have resulted in significant

improvements – in both increased capacity and increased quality –- in recycled material markets in the State. Some stakeholders favor focusing grants on R&D; however, many industry stakeholders feel that the grants are nearing the end of their useful lifespan, and would rather see available dollars go to MDPs.

The MDP allowed reclaimers to compete with the lower-priced flake coming into the State (much of it originally from California). Without the MDP, it is more difficult for reclaimers to find end-markets for their flake. When the DOR stopped making MDP payments in late 2008, due to budget constraints, recycled flake customers "panicked", and started buying flake from Canada, Mexico, and China. It costs approximately 48 cents per pound to produce recycled flake in California, but Chinese importers can sell their flake in California for only 42 to 43 cents per pound.

2. High Oil and Virgin PET Prices

When oil prices were $147 per barrel in July 2008, virgin PET prices were high as well, up to 85 cents per pound. Virgin PET prices dropped 34 percent, to 56 cents per pound when oil prices dropped down to approximately $50 per barrel. As one analyst commented, "as the price of gasoline goes, so goes the price of PET." Virgin PET prices are also influenced by the global demand for paraxylene and ethylene glycol feedstocks. Shortages and/or high prices for either of these two feedstocks tend to result in higher virgin PET prices.

Higher virgin PET prices typically result in higher recycled PET flake and pellet prices. However, the greatest margin between virgin and recycled pellets or flakes occurred when virgin PET was at its highest levels. When the margin is higher, end-users have a greater economic incentive to buy recycled, and reclaimers are able to better compete for recycled PET bales.

3. Technology Improvements

To the extent that reclaimers can improve quality and reduce costs, they will be better able to sell their end-product, and better able to compete with Chinese export markets to purchase recycled PET bales. Sorting contaminants from PET bales (after they have been broken), can be done manually or with optical sorting equipment. Because all bottles with barriers may not be captured with optical equipment, reclaimers may utilize both types of sorting technology. To the extent that containers can be more effectively sorted before they are baled, it will reduce back-end processing costs.

The ability to clean flake is a technical problem. There is equipment available that can clean flake to higher standards than some reclaimers currently utilize, for example by better removing labels. Reclaimers can charge a higher price for cleaner flake, and end-users can utilize higher levels of recycled content, thus increasing demand for recycled flake.

4. Higher Virgin PET Prices in China

High virgin PET prices in China skew the markets in favor of export. This is especially true when virgin PET prices in China are higher than in the United States. Because China's economy seems to be recovering from the economic downturn faster than the U.S., China's virgin PET prices increased in the spring of 2009, while U.S. virgin resin prices were lower. China's high prices allow Chinese recycled PET importers to bid even higher for recycled PET. California and domestic reclaimers are forced to raise their prices as well, in order to compete for material. However, if virgin PET prices in the U.S. aren't similarly high, the price margin between recycled flake and virgin PET shrinks, or may go negative.

D. New Market Alternatives and Opportunities

Markets for recycled PET in California are dominated by the Chinese export market. This creates challenging market conditions for those trying to process and utilize recycled PET in the State. However, most industry stakeholders would agree that California should not be as reliant as we currently are on export markets. This section describes eight alternatives that could help promote reclaiming and end-use of recycled PET beverage containers in California.

1. Create Incentives that Allow for New PET Reclaiming/Washing Capacity in California

In the May 2007, Market Update, we recommended that the DOC not invest in additional PET washing capacity at that time. This recommendation was based on the fact that there were a number of PET reclaiming facilities scheduled to come on-line in the next few years, many of them already funded by DOC grants. Two years later, only a fraction of this PET reclaiming capacity has been realized. The question remains, does California need additional PET washing/reclaiming capacity? The answer depends on who one asks.

Peninsula Packaging Vice-President Allen Kidd says, "finding an ongoing supply of clean, ground bottle scrap remains the biggest challenge" because of lack of bottle washing systems in the California marketplace (Plastics News, April 6, 2009, p.9). From this perspective, it seems that if the State had more flake capacity, there would be markets. However, there are only two California thermoformers that are consistently committed to purchasing recycled PET flake.

From a reclaimer's perspective, reclaimers are concerned because they are reliant on just a few end-users. While reclaimers are able to find end-markets today, they are worried about the future. It has been extremely difficult for reclaimers to operate in the State, as several companies that received grants have not been able to implement them. It could be risky for the DOR to simply award another grant to increase reclaiming capacity without addressing the underlying problems inherent in establishing reclaiming facilities in the State.

Thermoformers say they will purchase recycled flake for the right price, and the right quality. Reclaimers have some, but not total, control over these two variables. High PET bale prices drive up the price of recycled flake. High levels of contamination in PET bales drive up reclaimers' costs, and thus the price of recycled flake. Across the country, reclaimers are vertically integrating in order to reduce their uncertainty about end-markets. This results in even less recycled flake on the open market, and creates scenarios in which the reclaimer may also be competing with their end-use customers.

The PET flake/end-use dynamic is a classic "chicken or egg" problem, with a few extra twists. Which should come first, more PET reclaiming capacity, or a solid commitment by end-users to utilize recycled flake? Since neither entity controls the price variable, neither is willing to commit. On top of that, the cost of doing business in California, and the domination of Chinese export markets, make operating in California even more difficult. While it would be nice if California could process all, or even most, of our recycled PET in-State, no one in the industry expects that Chinese export markets will go away.

If California reclaimers took, for example, an additional 100 million pounds of PET out of the market, i.e. out of Chinese export markets, Chinese buyers would simply increase bale prices. Increased bale prices would negatively impact all reclaimers, as they would have to pay higher prices for raw material. This would likely result in a situation

similar to that faced by HDPE reclaimers in early 2009. Existing California HDPE reclaimers are operating below capacity, struggling to purchase enough material to meet customer needs, and operating on a negative margin. To understate, this is not a successful business model, and in fact, one industry stakeholder called this dynamic, "their worst nightmare," and another a "train wreck."

At the same time, Asian brokers are selling recycled flake and sheet back into the California thermoforming market. It is still cheaper to ship recycled PET bales to Asia, wash and flake the PET, and ship recycled PET flakes (or sheet) back to California, than it is to produce PET flake in California. This would be especially true, if bale prices were further increased by Chinese export buyers struggling to maintain their previous market share.

However, just letting China control California plastic markets is not a satisfactory outcome, particularly when Chinese government policies and subsidies allow Chinese business to out-compete California entities. The DOR cannot influence national and international trade policy to keep California PET in-the-State. However, several of the alternatives described in this subsection would help promote increased PET reclaiming capacity, and encourage end-users to utilize recycled PET produced in California. Four general approaches that can help California reclaiming are: (1) increase the quality of California PET bales and flake, (2) help make California reclaimers more competitive, (3) promote higher-value end-uses for recycled PET, and (4) promote increased use of California recycled PET by end-users.

2. Continue to Promote Design for Recycling/Bottle Testing

The increased use of barriers, additives, and labels that are not compatible with recycling is a critical issue for PET. Although funding has been (at least temporarily) suspended, NAPCOR received a DOC grant to conduct preliminary work to identify a university partner, and create a business plan, for a Design for Recycling Bottle Test Center. The concept would be that such a facility would eventually be self-sustaining with fees. A California Design for Recycling facility should work with other entities. The Association of Post Consumer Plastic Recyclers (APR) has established design for recycling criteria, and a Champions for Change Program, to encourage consumer product companies to test the recyclability of new containers with recyclers in the field.

The increased use of PET bottles with barriers increases the cost of recycling at the reclaimer level. There is no feedback mechanism to the bottle or beverage manufacturer. A reclaimer may have to hand-sort out bottles known to include barriers – significantly increasing their costs. While the DOR's processing fee is intended to, in theory, help cover the cost of recycling, there is no system in place to address the cost of reclaiming. The processing fee for a standard PET bottle is the same as the processing fee for a barrier PET bottle, even though the barrier bottle results in higher reclaiming costs.

Once there is an established and credible system in place for identifying problem PET bottles, the DOR could create a "reclaiming fee." The reclaiming fee would be assessed on containers that were contaminants in the recycling stream, thus creating an economic incentive to make containers more recyclable.[3] The reclaiming fee could be paid out to reclaimers to help cover their costs, just as the processing fee is paid out to recyclers to help cover the cost of recycling (in the form of a processing payment).

[3] The Design for Recycling Bottle Test Center and reclaiming fee could be extended to all container types, not just PET. One issue with a reclaiming fee is it could penalize containers such as bioplastics that are contaminants in PET, but have environmental benefits.

3. Promote Barriers that are Recycling-Compatible

Not all barriers create problems for recycling. Jureha Corporation is developing a new barrier, polyglycolic acid (PGA), called Kuredux, that is compatible with recycling. PGA enhances oxygen barriers, allowing PET bottles with PGA to be used for more beverage types than a standard PET bottle. This new additive is soluble in wash solutions, so it can be separated from PET during recycling. PGA will also allow for thinner walls for soft drinks, thus promoting light-weighting. PGA won't be commercially available until July 2010. To the extent practical, the DOR could promote the development and utilization of recycling-friendly barriers.

4. Promote Improved Quality of PET Bales

While California PET is higher quality than most of the rest of the country, there is room for improvement. Better quality bales filter through the entire system, reducing reclaiming costs, increasing the quality of flakes or pellets, and allowing end-users to increase recycled content levels.

The QIP is intended to help improve the quality of curbside PET bales; however, industry stakeholders do not believe that the plastic QIP is creating incentives for MRFs to improve bale quality. At MRFs, a significant number of PET containers are lost in the paper stream, and contamination of PET by aluminum and paper is often high.

In collaboration with entities such as APR, the DOR or a private entity could establish a rating or certification system for quality bales. Processors would apply for a clean bale certification, and then be subject to sampling to ensure that bale quality remained high. Processors with clean bale certification could ask for higher bale prices, and reclaimers would know they were receiving good quality bales.

One benefit of the economic downturn is that more consumers are returning containers at recycling centers, where they can receive CRV. This means more high-quality buyback containers, and fewer low-quality curbside containers, in the recycling stream.

5. Create Incentives to Produce and Utilize Washed PET by Restarting the MDP and Providing "Margin Insurance"

One of the best ways to promote additional washing capacity in California may be to re-establish the MDP. Over 2007 and the first three quarters of 2008, the MDP provided $10 million to PET and HDPE reclaimers and end-users, based on the quantity of washed PET or HDPE flake sold (by reclaimers) or purchased (by end-users). By creating a simple economic incentive to sell and utilize washed flake, the MDP over time, will promote the development of new California reclaiming capacity, and the utilization of greater quantities of California flake.

Several industry stakeholders noted that a major barrier to entry in PET reclaiming is the risk that the price of virgin PET will fall below the price of recycled PET. While reclaimers may expect that occasionally the margin will be negative, they cannot run a business over the long-term if margins are consistently negative. Unfortunately, the negative margins are often the result of high Chinese export prices – something over which California has no control.

An alternative that might be worth evaluating further is the use of "margin insurance." The DOR could establish margin insurance to help reclaimers cover negative margins, perhaps if negative margins lasted over a specified number of weeks. Margin insurance would consist of a few cents per pound paid to reclaimers based on the amount of recycled flake they sold during

periods of negative margins. By addressing the greatest threat to solvency that current and potential PET reclaimers face, margin insurance might provide the assurance necessary for potential reclaimers to moving forward.

A major barrier to implementing many of these alternatives is the lack of unredeemed funds. In mid-2009, the DOR is having to suspend and scale back programs, and is likely not in the position to add new programs that require unredeemed funds.

6. Increase PET Recycling

If there is more recycled PET available to purchase, it will be easier for reclaimers to meet their capacity needs. While PET recycling rates have increased each year, PET rates are still below those of aluminum and glass. Almost 225 million pounds of PET CRV beverage containers were not recycled in 2008. If additional PET wash and flake capacity is developed in California, the State will need to capture more material.

Although outside the scope of the Beverage Recycling Program, there is also opportunity to recycle and utilize PET thermoformed containers. Currently, these PET containers, many made using recycled PET beverage containers, are either thrown away, or recycled and shipped to China in bales of mixed plastic. The scrap price for these mixed plastic bales is only one cent per pound, far less than the estimated $500 per ton cost to recycle. With an improved collection infrastructure, there is reportedly no un-resolvable technical reason why thermoformed PET containers could not be recycled back into recycled PET flake – for use in thermoforming again, or perhaps even bottles. Brand owners would have to be willing to use less adhesive labels on thermoformed containers, a relatively easy problem to resolve.

7. Increase Recycled Content in PET Beverage Containers

Unlike aluminum and glass, recycled content in PET beverage containers is very low. Coke and Pepsi have committed to utilize 10 percent recycled content in their PET bottles, but have not consistently reached those levels. Coke achieved 10 percent recycled content in 2004 and 2005, but is now at only three percent recycled content. In 2009, Pepsi is reportedly reaching the 10 percent content target. It is technically possible to reach much higher levels of recycled content PET. Nestlé Waters North America has set a target of 25 percent recycled content by 2012. The two primary barriers to higher recycled content are low collection rates for recycled PET, and lack of bottle-to-bottle grade reclaiming capacity.

Breck Speed, CEO of Mountain Valley Spring Company, an upscale bottled water company located in Arkansas, began utilizing 25 percent recycled content in his company's PET water bottles in January 2009. Speed believes that there is no technical reason not to utilize 25 percent recycled content; they have had "zero quality issues." The company is currently laboratory and taste-testing PET water bottles with 50 percent recycled content; the bottles have been in Mountain Valley's warehouse for several months. It took Mountain Valley six months to gear up to the 25 percent recycled content level. The increase in manufacturing cost has been minimal, only a few cents to five cents per case.

One reason that Mountain Valley could make this shift to recycled content is that they are small, only purchasing about 10 million pounds per year of recycled PET to meet their content needs. Mountain Valley partnered with New Horizons Plastic Recycling to supply PET, and Veriplas Containers to produce the container. Speed believes that recycled content "is the right thing to do because it is the missing link in

creating economic demand for recycled PET. To spur recycling, you need someone who is willing to buy and reuse the material and we are committed to buying recycled PET... It is the right thing to do and a fairly common sense thing to do. PET resin is useful stuff and it is dumb to throw it away" (Plastics News, February 23, 2009, p.14).

The availability of bottle-grade recycled PET is definitely a constraint for recycled content PET. However, unless end-users make "bankable" commitments to utilize recycled PET, reclaimers cannot obtain financing to establish new capacity. As noted previously, most reclaimed PET is used internally. There are approximately 350 million pounds of merchant recycled PET in the U.S., and much of that capacity is not bottle-grade material. PET recycling, nationally, was only at 25 percent in 2007. Bottle-makers prefer to utilize recycled PET from bottle bill states. With the exception of bottle bill states, most recycled PET is curbside material, which is often highly contaminated. Since China will buy this contaminated material, there is relatively little incentive to produce higher quality PET. The process of sorting, cleaning, flaking, and pelletizing recycled PET into bottle-grade material can sometimes result in costs that are higher than virgin PET. Because there are equipment changes, inefficiencies, and uncertainties inherent in using recycled material, manufacturers are not willing to pay more for recycled material.

However, if the infrastructure was developed to support it, there is ample opportunity, through voluntary or mandatory initiatives, to increase PET (and other plastic resin) recycled content in bottles. Using the DOR's average PET container per pound figure of 14.6, there were approximately 590 million pounds of PET CRV bottles sold in the State in 2008. A 25 percent recycled content level would utilize approximately 150 million pounds of recycled PET, representing just 38 percent of PET recycled in 2008.

Table 4-2
Top Fifteen Bottle Blow Molders in the United States (Including most 2007 bottle sales (in millions)

1.	**Graham Packaging Co. LP**	**$2,195**
2.	**Amcor PET Packaging**	**$1,891**
3.	Plastipak Packaging Inc.	$1,323
4.	**Consolidated Container Co. LLC**	**$936**
5.	Southeastern Container Inc.	$775
6.	Constar International Inc.	$689.1
7.	Silgan Plastics Corp.	$627.4
8.	**Ball Corp.**	**$606**
9.	Alpla Inc.	$507
10.	**Berry Plastics Corp.**	**$419**
11.	**Liquid Container LP**	**$400**
12.	**Western Container Corp.**	**$304.5**
13.	CKS Packaging Inc.	$256
14.	**Ring Container Technologies Corp.**	**$220**
15.	**Alcan Packaging**	**$205**

Source: Plastics News, November 10, 2008, p.18.)
(Companies with facilities in California are bolded.)

Table 4-3, on page 4-28, identifies 15 plastic blow-molding (i.e. bottle-making) companies with facilities located in California. **Table 4-2,** above, identifies the top fifteen bottle blow-molding companies in the United States. Those companies with facilities located in California are bolded. Many of these companies produce PET bottles, and could potentially utilize recycled content, if bottle-grade material was available. While many of these companies are against recycled content mandates, there are others that believe that the industry will not utilize recycled content unless they are forced to (via recycled content mandates).

8. Promote New PET End-Markets

There are limited markets for colored (mostly green) PET. Various entities have been evaluating and seeking to develop alternatives that utilize the colored PET recycling stream. None of these

alternatives is moving forward rapidly, as there seem to be a number of start-up issues inherent in developing new end-use alternatives such as these. Two promising end-use alternatives that have had difficulty starting up are: recycled PET as a package coating on corrugated fruit boxes, replacing wax; and recycled PET insulation. Both of these alternatives can utilize colored PET.

The colored PET issue can also be addressed at the front-end. Plastic Technologies Inc. in Ohio, has developed a new PET foam bottle technology. Their process produces a white or silver PET bottle that will not contaminate the clear PET recycling stream, and allows for thinner walled containers.

There is one high-value recycled PET end-market that has also been slow in developing, but still holds promise. Sabic Innovation Plastics (Sabic IP) is producing the iQ-brand resins made from upcycled PET water bottles. This technology was originally developed by GE Plastics. The resin, replacing PBT (polybutyrate terephthalate) is being sold under the brand names Valox iQ* and Xenoy iQ*. Both products are polycarbonate and recycled PET blends. These resins can be used in automotive applications such as connectors, mud guards, lighting bezels, energy absorbers, or body panels. While these resins are being produced at a small scale today, this end-use alternative would work best on a large scale. The major benefit of this option is that there is a large spread between the raw material price and finished product prices.

Table 4-3
Plastic Blow Molding Facilities in California (Bottle Making Emphasis)

Company	Headquarters	California Locations	Materials	End Markets	Blow molding Sales (Total) (Millions)	Annual resin throughput (Millions of pounds)
1. Graham Packaging Co. LP	York, PA	Modesto, Oakdale, Richmond, and Santa Ana	HDPE-co, HDPE-h, PET, PP, PC, PVC, LDPE	3, 4, 5, 7, 10, 11, 12, 13, 14, 15, 16, 22	$2,195	NA
2. Amcor PET Packaging	Ann Arbor, MI	Fairfield, Commerce, Lathrop, Brea, and San Marcos[4]	PET	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14	$1,891	NA
3. Consolidated Container Co. LLC	Atlanta, GA	Anaheim, Carson, Ontario, City of Industry, Riverside, Industry, Santa Ana, and Tracy	HDPE-co, HDPE-h, PET, PP, PC, PVC, LDPE	1, 3, 4, 5, 10, 11, 12, 13, 14, 15, 16, 22	$936	NA
4. Ball Corp.	Broomfield, CO	Chino	PET, PP	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	$606	NA
5. Berry Plastics Corp.	Evansville, IN	Anaheim, Lathrop, and Redlands	HDPE-co, HDPE-h, PET, PP, PVC, LDPE	1, 3, 4, 5, 10, 11, 12, 13, 14	$419	NA
6. Liquid Container LP	West Chicago, IL	Modesto and Rancho Cucamonga	HDPE-co, HDPE-h, PET	4, 10, 11, 13, 14, 16	$400	NA
7. Western Container Corp. (for Coca-Cola)	Midland, TX	Benicia and Rancho Cucamonga	PET	1, 6, 7, 8, 9	$304.5	NA
8. Ring Container Technologies Corp.	Oakland, TN	Stockton and Fontana	HDPE-co, HDPE-h, PET	5, 10, 13, 16	$220	NA
9. Alcan Packaging	Pennsauken, NJ	American Canyon	HDPE-co, PC, LDPE	12, 14	$205	NA

Sources: Plastic News, November 10, 2008, and company web pages
NOTE: when company has multiple locations (including outside California), the information provided is for the company overall, not just the California plants

Abbreviations Key

HDPE-co: HDPE copolymer
HDPE-h: HDPE homopolymer (dairy)
HDPE-m: HMW HDPE (film)

End-markets Key

1. Beverage (still water)
2. Beverage (carbonated water)
3. Beverage (milk)
4. Beverage (juice, stable)
5. Beverage (juice, refrigerated)
6. Beverage (soda, 3+ liter)
7. Beverage (soda, 2+liter)
8. Beverage (soda, 1+liter)
9. Beverage (soda, single serve)
10. Other food
11. Motor oil/car care products
12. Medical/pharmaceutical
13. Household chemicals
14. Personal-care packaging
15. Toys
16. Industrial/agricultural chemicals
17. Drums
18. Other industrial packaging
19. Automotive parts
20. Trash cans
21. Furniture
22. Lawn and garden
23. Pallets

[4] Midway Container

Table 4-3

Plastic Blow Molding Facilities in California (Bottle Making Emphasis) *(continued)*

Company	Headquarters	California Locations	Materials	End Markets	Blow molding Sales (Total) (Millions)	Annual resin throughput (Millions of pounds)
10. Pretium Packaging LLC	St. Louis, MO	Anaheim	HDPE-co, HDPE-M, PET, PP, PVC	4, 5, 10, 11, 12, 13, 14, 16	$185	NA
11. Poly-Tainer, Inc.	Simi Valley, CA	Simi Valley	HDPE-co, PET, PP, PVC, LDPE	10, 11, 12, 13, 14, 16, 18	$23.9	6
12. Plascor, Inc.	Riverside, CA	Riverside	HDPE-co, PP, PC, PVC, LDPE	10, 11, 12, 13, 14, 16	$13.2	4
13. Microdyne Plastics, Inc.	Colton, CA	Colton	HDPE-co, HDPE-h, HDPE-m, PET, PP, PC, DLPE, ABS	10, 11, 12, 13, 14, 18	$8	6
14. Bomatic Inc.	Ontario, CA	Ontario	HPDE-co, HDPE-h, PET	3, 4, 5, 13, 16	$8	9
15. DaMar Plastics Inc.	San Diego, CA	San Diego	HDPE-co, HDPE-h, HDPE-m, PET, PP	1, 2, 3, 5, 10, 11, 12, 13, 14, 16, 18	$1.5	NA

Sources: Plastic News, November 10, 2008, and company web pages

NOTE: when company has multiple locations (including outside California), the information provided is for the company overall, not just the California plants

Abbreviations

HDPE-co: HDPE copolymer
HDPE-h: HDPE homopolymer (dairy)
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End-markets Key

1. Beverage (still water)
2. Beverage (carbonated water)
3. Beverage (milk)
4. Beverage (juice, stable)
5. Beverage (juice, refrigerated)
6. Beverage (soda, 3+ liter)
7. Beverage (soda, 2+liter)
8. Beverage (soda, 1+liter)
9. Beverage (soda, single serve)
10. Other food
11. Motor oil/car care products
12. Medical/pharmaceutical
13. Household chemicals
14. Personal-care packaging
15. Toys
16. Industrial/agricultural chemicals
17. Drums
18. Other industrial packaging
19. Automotive parts
20. Trash cans
21. Furniture
22. Lawn and garden
23. Pallets

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Section 5

HDPE

5. HDPE

HDPE became part of the Beverage Recycling Program in 2000, with the addition of juice, sports drinks, water, coffee, and tea. Prior to 2000, HDPE containers were commonly recycled through curbside programs, and most HDPE is still handled through the curb. The most common HDPE beverage container is milk jugs, which are not currently within the Beverage Recycling Program.

The HDPE reclaiming industry is well established, with three companies able to handle much of the HDPE that is recycled. The predominant market issues for HDPE in 2007 were: (1) increased exports to China, (2) continued high prices for recycled HDPE, (3) increased demand for recycled HDPE among end-users, (4) a decline in total HDPE bottle production, and (5) a lack of supply of recycled HDPE. In 2009, all five of these market issues are of concern, with conditions related to exports and price significantly worse than they were in 2007.

A. Material Flows and Market Players

The HDPE recycling rate in the 2008 was at the highest level ever of any material within the Program, 91 percent. **Figure 5-1,** on the next page, provides the CRV containers sold and recycled, non-CRV (postfill) containers recycled, and CRV recycling rate for HDPE since the resin was added to the Program in 2000. In terms of total containers (and tons) recycled, HDPE is the one material for which non-CRV containers are more numerous than CRV containers.

On the positive side, the HDPE recycling rate has been increasing steadily since 2003. Since one of the major issues with HDPE is lack of supply, the increasing recycling rate is a good development. However, some industry experts noted that the high recycling rate for HDPE may actually include the weight of some CRV plastic resins #3 to #7. It is common practice among recyclers to pay CRV to customers for #3 to #7 plastic bottles, then toss the bottles in a bin mixed with HDPE. Recyclers often follow this practice because there are so few #3 to #7 plastic containers that it is not worth their time to claim the #3 to #7 bottles. However, when the #3 to #7 bottles are left with the HDPE, they end up being counted (weighed) in the HDPE. This practice could skew the HDPE recycling rate upward.

Between 2006 and 2008, total pounds of HDPE recycled in California increased 10 percent. As Figure 5-1 and **Figure 5-2,** on page 5-3, illustrates, the majority of recycled HDPE consists of non-CRV containers. Even though more CRV HDPE is collected at recycling centers (RCs) (79 percent at RCs versus 21 percent at curbside), the majority of all HDPE, 78 million pounds, is collected through curbside programs.

Figure 5-1
HDPE Beverage Containers Sold and Recycled and Postfilled Containers Recycled (2000 to 2008)

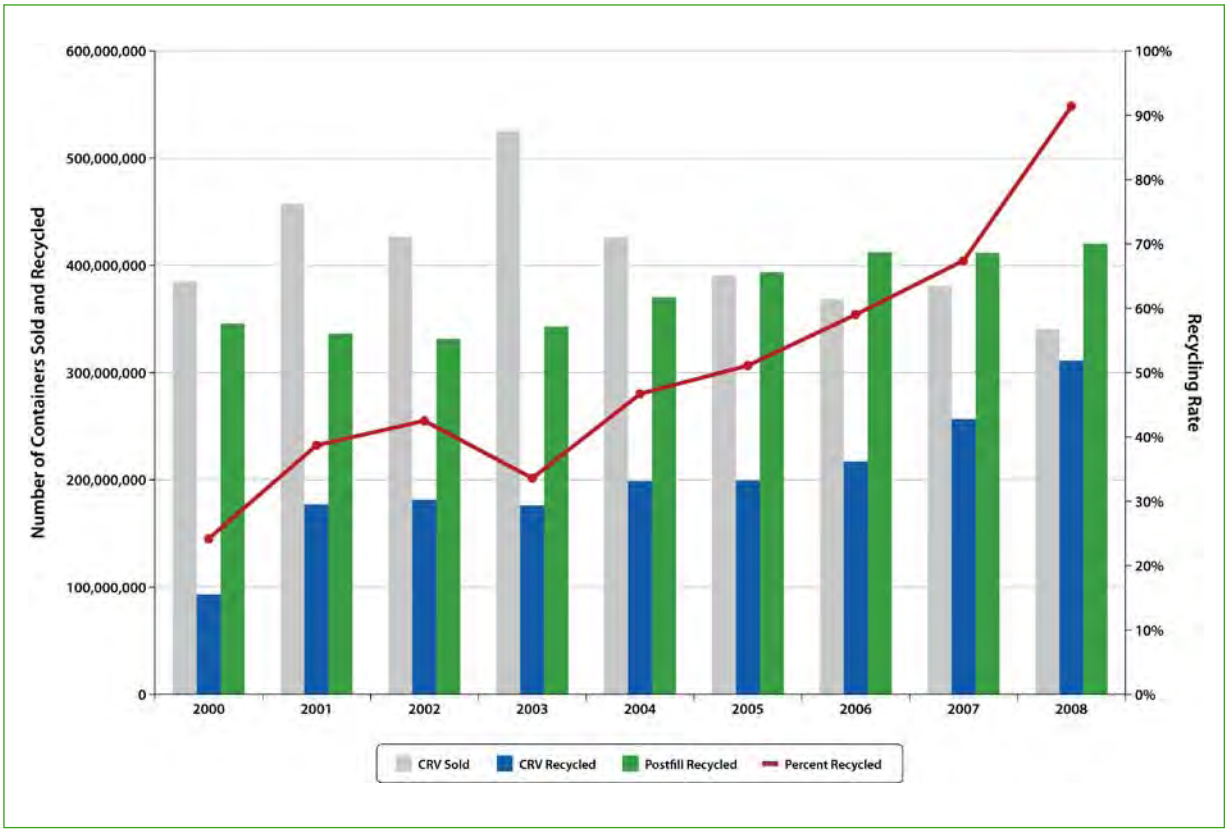
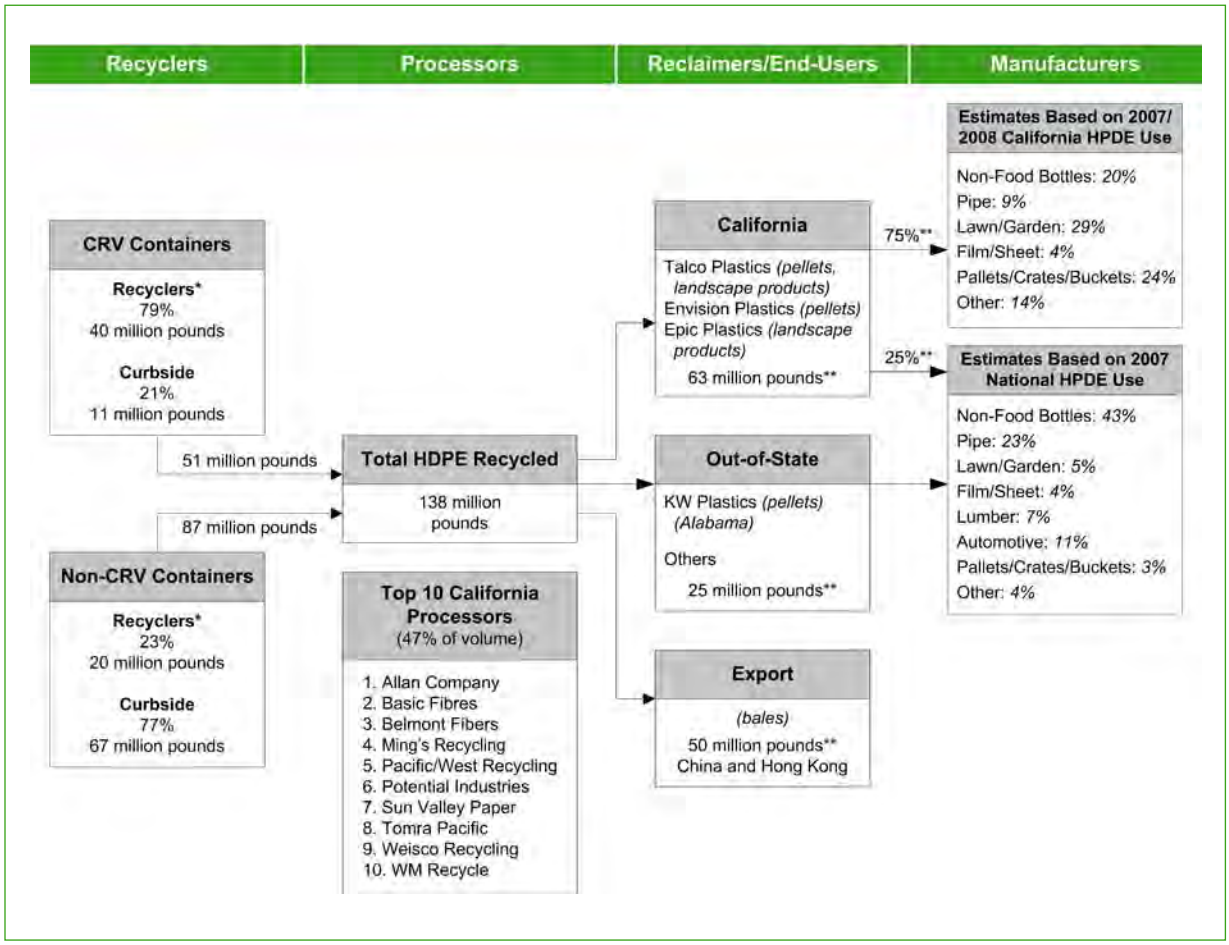


Figure 5-2 illustrates the flow of recycled HDPE. The top 10 processors, listed in alphabetical order in Figure 5-2, handled only 47 percent of the total HDPE volume. The remaining HDPE is handled by 86 additional processors. There are three major end-use destinations for HDPE: 1) California's three reclaimers, 2) other domestic end-users located out-of-state, and 3) export, primarily to China and Hong Kong.

Talco Plastics – Talco, located in Long Beach, sorts, grinds, washes, and produces pellets from post-consumer and post-industrial HDPE. The company sells to both the bottle and durable goods industries. Talco has received two DOR grants, which they have used to expand capacity and increase efficiency of their operations. The first grant expanded capacity for post-consumer HDPE from 18 to 20 million pounds per year, to 25 million pounds per year. The second grant, completed in early 2009, increased Talco's capacity to 30 million pounds. This grant included equipment to color and polymer sort mixed colored bales of HDPE.

Envision Plastics – Envision, located in Chino, is the recycling arm of Ecoplast, Inc., one of the country's large plastic compounders. Envision produces recycled content pellets to their user's specifications, ranging up to 100 percent recycled content. Envision also has received two DOR grants, one for optical sorting and to increase capacity to approximately 30 million pounds, and one to install a patented technology to produce food-grade recycled HDPE. The second grant is still in process. Envision also has a recycling facility in North Carolina.

Figure 5-2
HDPE Recycling and End-Uses in California (2008)



* Recyclers includes traditional and supermarket RCs, collection, drop-off, and community service programs. For non-CRV volume, also includes non-certified entities.

** Estimated quantities.

Epic Plastics – Epic Plastics, located in Lodi, produces benderboard and a variety of other landscape products utilizing mixed-color HDPE. Epic flakes and washes the HDPE, then utilizes it directly in an extrusion process to produce end-products. Epic has received two grants, one to install optical sorting equipment, and one to expand production capacity to supply outside manufacturers. The second grant is still in process.

Outside California, KW Plastics (Troy, Alabama) is a dominant player in California's HDPE markets. Over the last several years, KW Plastics has purchased between 25 million and 40 million pounds annually of California HDPE. KW Plastics is the largest plastic recycler nationwide, with an estimated $223 million in sales. KW Plastics is successful because they operate at very high volumes; have been willing to invest in equipment, including an automated continuous process; and they manage transportation through their own trucking capacity. KW has capacity to produce almost 500 million pounds of recycled resin annually, equally divided between polypropylene (PP) and HDPE.

Figure 5-2 provides estimates of the percent of HDPE used nationally, by end use. California end-use estimates, based on 2007 and 2008 MDP payments, are provided in Figure 5-2. The majority of HDPE reclaimed within California is used by manufacturers in the State. Compared to national HDPE utilization, more California HDPE is used in lawn and garden products, and various pipes, crates, and non-bottle containers. Less California HDPE is used in non-food bottles, as compared to national utilization rates. Typically, natural HDPE is utilized in non-food application bottles, and colored HDPE is utilized in pipe, and lawn and garden products.

There are (at least) two categories of end-use purchasers of recycled HDPE: those that are required (or chose) to use recycled HDPE, and those that use recycled HDPE due to the lower price. The first category of recycled HDPE user expects to pay less for recycled HDPE than for virgin, but is less price sensitive. The second category of recycled HDPE user purchases recycled HDPE because it is less expensive than off-spec resin. These second category of end-users typically produce lower-value products and purchase in large quantities. The second category of end-user will readily shift away from recycled resin if off-spec resin is available for less than the price of recycled resin.

For end-users, a key advantage of using recycled HDPE over virgin HDPE is cost. The cost differential between virgin and recycled resin depends on the market. The amount of recycled versus virgin resin that an end-user incorporates into products typically depends on their customers. Some customers prefer only a certain percent of recycled material, while others will specify up to 100 percent recycled. In using recycled HDPE, the primary concern is quality. Contaminants, such as paper, trash, and metals, will cause the plastic to stick to equipment, and/or damage machinery.

In 2007, there were a total of 29 HDPE reclaimers operating in the United States. This figure includes the three HDPE reclaimers in California. Aside from KW Plastics, no other domestic reclaimers handle significant quantities of California HDPE. Overall, HDPE reclaimers in the United States were operating at less than 70 percent capacity in 2007.

The role of export in HDPE material flows has shifted over the last several years. Nationally, HDPE recycled bottle exports increased almost 48 percent between 2004 and 2007, up to 214 million pounds. Total ethylene (including all types of recycled HDPE, LDPE, LLDPE materials) exports from California ports increased 7 percent between 2007 and 2008, to 439 million pounds. Most of the ethylene scrap was sent to China or Hong Kong (95 percent). China has historically been in-and-out of California's HDPE export market, sometimes purchasing significant amounts of HDPE for several months, and then cutting back significantly. Over the last few years, China's role, and influence, in California's recycled HDPE markets has been strong.

Figure 5-2 illustrates estimated material flows for California HDPE in 2008. It is important to note that the flow of HDPE has changed significantly since 2008. In the 2007 Market Analysis, we estimated that in 2006, approximately 50 million pounds (40 percent of generation) of HDPE was exported. In 2008, we estimate that HDPE bottle exports were approximately 36 percent of generation, again at 50 million pounds. In early 2009, industry experts noted that as much as 90 percent of California's recycled HDPE was exported, primarily to China and Hong Kong. If these export levels are maintained through the year, HDPE exports to China and Hong Kong could exceed 100 million pounds in 2009. This would leave significantly less HDPE for California reclaimers.

B. Current Market Dynamics

Since late 2008, markets for recycled HDPE, like other commodities, have been extremely volatile. In early October 2008, baled, natural HDPE was approximately 40 cents per pound on the West Coast. Prices dropped over 10 cents per pound during the month of October, and then dropped an additional 12 cents in the first week of November – more than a 50 percent price drop in one month. Prices for baled HDPE stayed at approximately 10 cents per pound for nine weeks, before starting to climb upwards in mid-January.

Prices declined as part of the general economy-wide collapse in October/November 2008. However, a major factor in the precipitous drop in California recycled HDPE (and PET) prices was the almost complete shutdown of exports to Asia during this time. When prices were low, many recyclers stored recycled materials, rather than selling at low prices. The result was a significant slow-down in material flow. Recycled HDPE survived the recent market crash; however, there are still significant issues affecting recycled HDPE markets in California.

In the first several months of 2009, there were seven key factors contributing to recycled HDPE market dynamics in California. By far, the most critical factor was domination of Chinese export markets. At the time this report was written, it was extremely difficult for California's three HDPE reclaimers to obtain material. KW Plastics, a major end-user of California recycled HDPE, exited the California market entirely. Other market issues, inter-related but far outweighed by the export issue, were: high scrap prices for recycled HDPE; oversupply of virgin and off-spec HDPE resin in the United States; weakening demand for virgin HDPE and recycled HDPE; suspension of the MDP; contamination of HDPE bales; and lack of supply of recycled HDPE.

1. Domination of Exports to China and Hong Kong

Exports to China have always played a significant role in California's recycled HDPE markets. Over the last few years, China has played an increasingly important role for recycled HDPE. In 2006, exports of HDPE to China accounted for approximately 40 percent of end markets. In the Spring of 2009, approximately 90 percent of California's recycled HDPE containers (CRV and non-CRV) were being exported to China and Hong Kong. While it is technically illegal to import whole bottle scrap into China, it is apparently common practice to send the materials first to Hong Kong, and then to China. The bottle scrap is sometimes processed in Hong Kong, or simply smuggled into China.

Even when "only" 40 percent California's recycled HDPE was exported, there were supply shortages for the three California HDPE reclaimers. California and domestic demand for recycled HDPE is greater than the supply of recycled material. The current high export levels in 2009 are making it extremely difficult for HDPE reclaimers to operate. In early 2009, California's three HDPE reclaimers were only able to obtain between 25 percent and 65 percent of the recycled HDPE they were seeking to purchase. As a result, California reclaimers are running far below capacity, collectively at approximately 50 percent. All three reclaimers have had to cancel end-product orders and/or turn away new business. While the slow economy is, to some extent, reducing demand for recycled HDPE pellets, reclaimers will have significant difficulty obtaining recycled HDPE feedstock, and maintaining end-use customers, if the current situation continues.

One could argue that if California reclaimers cannot compete with China for recycled HDPE, then perhaps it is better that the material is exported. The situation, however, is not simply an

issue of competitive advantage. Clearly, China has lower labor costs that allow for a strong recycling industry. China's recycling system has been built on the power of manual sorting and low cost shipping between California and the Pacific Rim. When the economy was strong, and China was exporting products to the United States, there was an ample supply of empty shipping containers waiting in California's ports. In 2007, shipping costs from California to Asia, essentially subsidized by Chinese exports of finished goods, were as low as one (1) cent per pound.

The current export situation is complicated by China's economic stimulus policies. Two aspects of China's economic stimulus are allowing Chinese buyers to offer significantly higher prices for recycled HDPE. In order to boost manufacturing in China, the country has reduced or eliminated tariffs on raw material imports. These tariffs were as high as $3,000 to $4,000 per 42,000 pound container of recycled plastic – equal to a 7 to 9 cents per pound additional fee. In May 2009, with the tariffs eliminated, it cost as little as $75 per 42,000 pound container to ship from California to Hong Kong – only 0.18 cents per pound. Shipping the same container across the United States would cost $2,400, or almost 6 cents per pound.

In addition to quota reduction or elimination, the Chinese economic stimulus package included over $17 billion in changes to value-added taxes to support domestic industries. Together, these programs are allowing Chinese manufacturers to pay "astronomic prices that don't make economic sense" in relation to the price of virgin and off-spec HDPE resin. Chinese buyers are offering at least 4 to 5 cents more per pound than U.S. reclaimers.

Tammie Ettefagh, of Envision Plastics commented, "we can't pay the prices [that recyclers outside the U.S.] pay for recycled HDPE because we don't have the subsidies they have and there is not an economic advantage for our customers to use recycled content. We are hurting domestically, because we are not subsidized and don't have mandates to use recycled content outside California" (Plastics News, March 9, 2009, p.1).

2. High Scrap Prices for Recycled HDPE

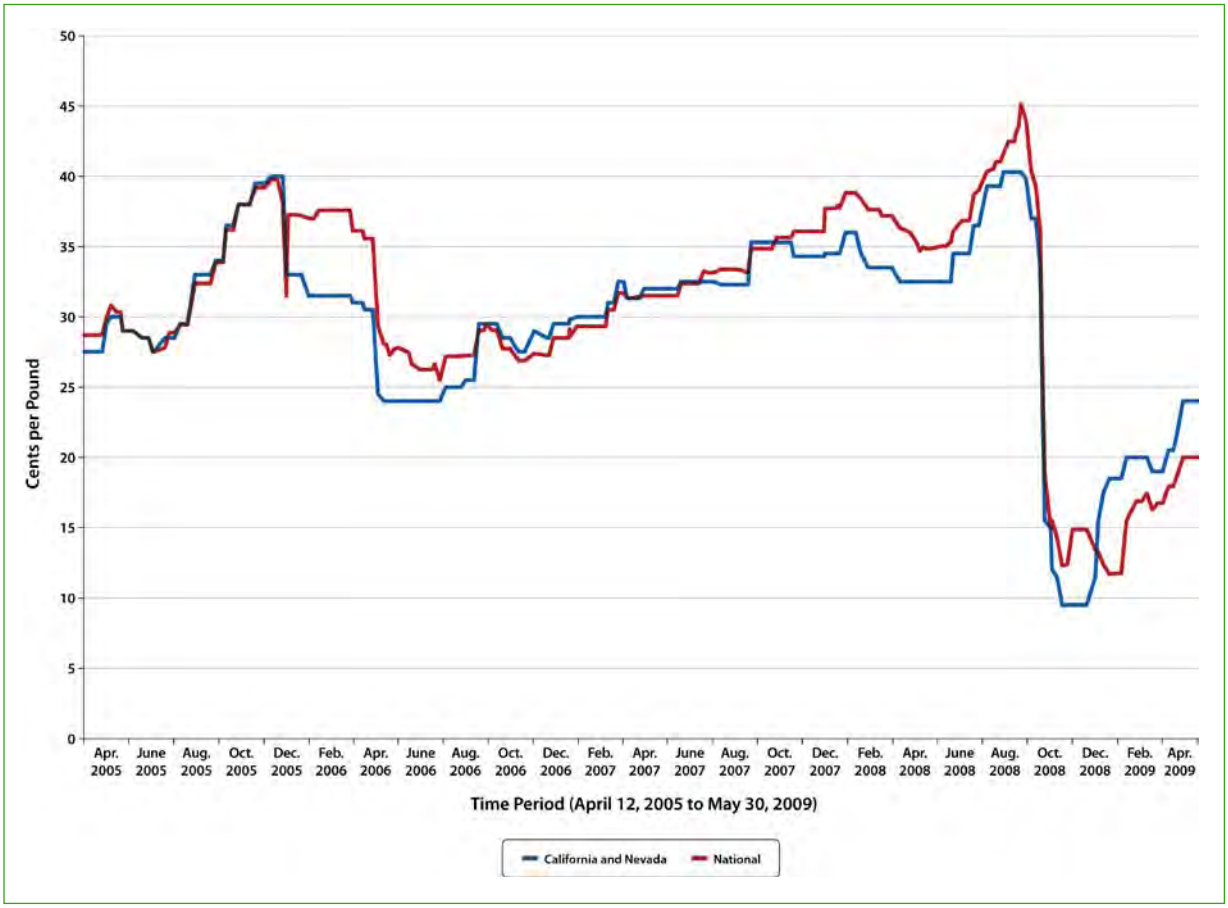
High scrap prices for HDPE are directly linked to the strong Chinese export market. Because they are able to pay extraordinarily high prices for recycled HDPE, China currently has "complete control of the HDPE market".

Current (and periodic) dominance of the export market in California is evident in **Figure 5-3,** on the next page. This figure compares the weekly average price of HDPE bales in California and Nevada, to the national average.[1] When the California average is higher, it is because export markets have driven the price upward. As Figure 5-3 illustrates, generally the regional and national prices were within a few cents. When Chinese markets closed in November and December 2008, prices in California were significantly lower than national prices. As the export market picked up in late January, the average price in California increased, surpassing the national average.

Figure 5-4, on page 5-8, illustrates the annual statewide HDPE average scrap prices paid by processors. These are the scrap prices used in the processing fee and processing payment calculations. Over the last several years, prior to the recent price drop, HDPE scrap prices have been at

[1] The national average includes the price in the California/Nevada region, however, export plays a smaller role at the national level. Thus, the national price is a better reflection of the price domestic reclaimers are paying for recycled HDPE.

Figure 5-3
Comparison of Natural HDPE Bale Prices (Picked Up), Regional versus National
(April 12, 2005 to May 11, 2009)



high levels. High scrap prices for recycled HDPE act positively on recycled HDPE markets, when they are correlated with high virgin resin prices. The problem with the current market dynamic, is that virgin resin prices are low.

Figure 5-5, on the next page, illustrates the monthly statewide average HDPE scrap value paid by processors to recyclers. Figure 5-5 illustrates the extreme fluctuations in HDPE scrap values over the last year.

3. Oversupply of Virgin and Off-Spec HDPE in North America

United States HDPE reclaimers are operating under an entirely different dynamic than Chinese reclaimers. United States HDPE reclaimers must purchase recycled HDPE at a price that allows them to sell their finished product (recycled HDPE pellets) below the price of virgin and off-spec resin in North America. The export problem is compounded by the oversupply of virgin and off-spec HDPE resin in the United States – a symptom of the down economy.

Figure 5-4
HDPE Average Scrap Values (1999 to 2008)

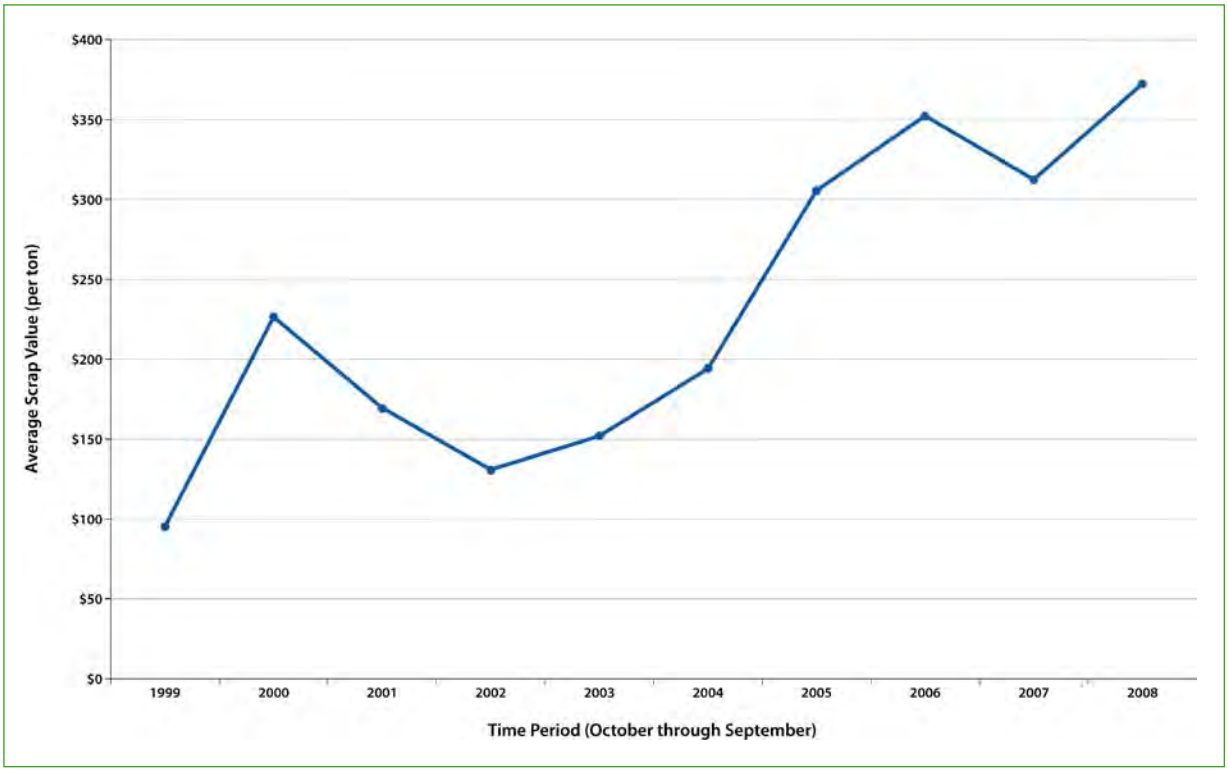


Figure 5-5
HDPE Average Scrap Values By Month (February 2008 to February 2009)

The slowdown in the economy coincided with new virgin HDPE capacity coming on-line, exacerbating the virgin oversupply. Virgin HDPE production was at 70 percent capacity in the end of 2008, and sales of domestic virgin HDPE were down in 2008. Analysts expect that demand for virgin HDPE will bottom out in 2009, and make a slow recovery in 2010. Most new global HDPE expansion that had been planned for 2008 to 2009 is currently on hold, which may help to even out supply and demand for the resin.

If HDPE end-users can obtain virgin and off-spec HDPE for low prices, they have no incentive to purchase recycled HDPE, especially when it is almost as expensive as virgin. From the end-user's perspective, the price differential between recycled and off-spec or virgin resin must make up for real and/or perceived reductions in quality, flow-through, or other operating efficiencies that result from using recycled resin. Increasingly, end-users may seek out recycled resin to reduce their environmental impact, but rarely will they pay more than virgin. Many end-users prefer to pay no more for recycled resin than the price of off-spec resin, which is typically two to three cents per pound less than virgin resin.

4. Weakening Demand for Virgin and Recycled HDPE

HDPE bottle resin sales have not changed significantly over the last several years. A major reason for the slow-to-no growth in HDPE is the down-sizing or light-weighting of containers. Non-food products such as detergent and motor oil make up major markets for both virgin and recycled HDPE. Major detergent manufacturers have shifted to concentrated solutions, reducing the size of the bottles. Manufacturers also seek to minimize the amount of resin in containers, as a way to reduce costs. These changes have positive overall environmental impacts – reducing the amount of resin used – but they also decrease the potential supply of recycled HDPE, and potential end-markets for recycled resin.

HDPE reclaimers have noticed a drop-off in demand for recycled flake due to the slow economy. However, reclaimers are able to sell all their product, and given the lack of availability of bales, reclaimers are more worried about not having enough material to meet demand. Overall, the demand for recycled HDPE is far greater than the supply.

5. Suspension of the DOR's Market Development Payment (MDP)

Another compounding factor acting against California HDPE reclaimers is the suspension of the MDP. MDPs were established by AB 3056 to develop California markets for recycled empty plastic beverage containers. Taking into account non-CRV HDPE, the effective MDP was four cents per pound total – two cents to the reclaimer, and two cents to the end-user. MDPs were distributed in 2007, and for the first three quarters of 2008 (when the $5 million per year in funds ran out). In 2009, due to budget restrictions, the MDPs have been suspended for an unknown period. The MDPs were considered by the vast majority in the industry (including those that did not benefit from them), to be an equitable way to support recycling infrastructure, and help California reclaimers and end-users compete with China.

6. Contamination of HDPE Bales

Since beverage containers in plastic resins #2 to #7 were added to the Beverage Recycling Program in 2000, California has had a problem with increased contamination of HDPE bales, particularly colored HDPE. The Association of Postconsumer Plastics Recyclers model bale specifications note that contaminants in either natural or colored HDPE bales should not exceed 10 percent. Contamination levels of typical California HDPE bales have increased from 10 to 15 percent, to 25 to 35 percent.

Table 5-1
Hypothetical Comparison of Effective Price Per Pound for HDPE Bales

Contamination Level	Bale Weight	Price per Pound	Total Purchase Price	Actual HDPE Weight	Effective Price per Pound
10%	1,100 lb.	20 cents/lb.	$220	990 lb.	**22 cents/lb.**
35%	1,100 lb.	20 cents/lb.	$220	715 lb.	**31 cents/lb.**

These high contamination levels effectively increase the price, and reduce the quantity, of recycled HDPE. **Table 5-1,** above, compares the effective price per pound and quantity of HDPE from a bale with 10 percent contamination, to a bale with 35 percent contamination. With high levels of contamination, reclaimers are paying more money, for less HDPE.

There are several reasons for California's low quality HDPE bales. As noted previously, with the addition of small numbers of plastics #3 to #7 in the CRV system, it has become common practice for recycling centers to throw the few #3 to #7 containers that they do receive in with the colored HDPE. Second, at the curbside level, where much of the HDPE is recycled, the conversion to single stream has resulted in higher levels of mixing and contamination. Third, Chinese buyers are willing to pay high prices for HDPE, no matter how contaminated. Recyclers have no incentive to produce higher quality material.

In China, the low cost of labor means that it is relatively inexpensive to sort highly contaminated HDPE bales. In California, it is much more expensive to sort those same bales. All three California HDPE reclaimers have received grant funds to purchase optical sorting equipment to address contamination. However, the improved ability to sort bales does not lower the price.

In relation to contamination, Scott Saunders of KW Plastics in Alabama noted that, "bales of HDPE, specifically mixed colors, continue to be the dumping ground for every bottle that people don't know what to do with" (Plastics News, May 26, 2008, p.9).

7. Lack of Supply of Recycled HDPE

As Figure 5-1 illustrates, the amount of HDPE recycled has increased over the last several years. Most of the increase is a result of higher levels of CRV recycling, while postfill recycling has remained fairly constant. Even with these modest increases, there is not enough recycled HDPE to fill demand. This is particularly evident when the export market is strong. However, any increases in HDPE recycling could be easily absorbed. The annual United States Post-Consumer Plastics Bottle Recycling Report states that the HDPE recycling industry has been supply limited since 1996.

A final concern related to recycled HDPE is the use of additives in HDPE containers, such as calcium carbonate (CaCO3). Calcium carbonate is used as a filler in HDPE containers to reduce the amount of petroleum-based material. The use of calcium carbonate changes the specific gravity of the plastic, reducing the effectiveness of float-separation technologies. APR identified this problem in 2007, and has been working to educate bottle-makers and recyclers about the issue.

Figure 5-6, on the next page, illustrates current and projected capacity and utilization for California HDPE. California's three HDPE reclaimers currently have capacity for approximately 75 million pounds of HDPE annually. This is approximately one-half of the HDPE generated in the State. KW Plastics typically utilizes between 25 and 40 million pounds of California HDPE, but could use as much as 75 million pounds. Currently, because of price, KW Plastics is not sourcing any HDPE from

Figure 5-6
Estimates of Current and Future HDPE Reclaiming Capacity (Millions of pounds)

End-Use	2009 Capacity	2009 Utilization Scenario	2012 Potential Capacity Scenario
California HDPE Reclaimers			
Talco Plastics	75	40	90
Envision Plastics			
Epic Plastic			
Domestic U.S. Reclaimers			
KW Plastics	75	0	75
Others			
Export			
China	50	105	50
Hong Kong			
Other			
Total Reclaimed/Exported	200	145	215
Total Recycled	145	145	160
Supply Shortfall	**55**	0	**55**
California Unused Capacity		**35**	

California. The remainder of California's HDPE is exported.[2] Although there is plenty of domestic HDPE reclaiming capacity, there will always be a substantial portion of California HDPE that is exported to Asia.

Figure 5-6 includes a projection for 2009 utilization and export, assuming that current market conditions hold for the entire year. This is a worst-case assumption, and is included to illustrate the challenges facing the industry. If HDPE exports continue at the high levels of early 2009, California's HDPE reclaimers will only be operating, on average, at 50 percent capacity. Exports would double from 2008 to 2009, and California HDPE reclaimers would have a capacity shortfall of approximately 35 million pounds.

The future capacity estimates in Figure 5-6 are just that: estimates. In the current market, industry analysts are hesitant to predict future market dynamics for HDPE. The reclaiming industry is hopeful that they can "ride out" the current difficulties, and that end-users will not switch away from using recycled HDPE. As Figure 5-6 illustrates, even if capacity expands in 2012, and exports remain at a more typical 50 million pounds per year level, there will be a supply shortfall of 55 million pounds of HDPE.

At this point in time, the HDPE reclaiming industry is not focused on future expansion, but rather on survival. None of California's three HDPE reclaimers are able to obtain enough

[2] It is difficult to determine exactly how much California HDPE, in bottle form, is exported. Department of Commerce data for California plastic exports combine many grades of polyethylene (HDPE, LDPE, LLDPE). The data also includes some HDPE that may be brought to California, then exported. Thus, our figures for California HDPE exports are based on total generation, minus California use (from reclaimers) and domestic use. National HDPE bottle exports in 2007 were 214 million pounds.

HDPE to meet current capacity or end-use demand. The HDPE industry is supply limited. While the slow economy has resulted in somewhat fewer orders from end-use manufacturers, there is still significant demand for recycled HDPE.

C. Market Influences

Figure 5-7, on the next page, illustrates the market influences for HDPE. As these factors shift in significance, the dynamics change in favor of California (and to some extent other domestic) reclaimers, versus export. The factors on the positive side all act to increase the opportunity to use recycled HDPE in California. The factors on the negative side all act to increase the incentives to export recycled HDPE. We discussed the negative pressures above, as they relate to current market dynamics. Below, we identify how the positive pressures act to increase the ability of California reclaimers to utilize recycled HDPE:

1. DOR's MDP

The MDP provides economic incentives to reclaim and utilize recycled HDPE within California. When it was in effect, the extra few cents per pound helped somewhat to level the playing field for California reclaimers and manufacturers. Another positive aspect of the MDP is that it is relatively simple, and as long as it is being implemented, consistent in application. If a reclaimer or end-user utilized the material, and completed the paperwork, they received the payments.

There is no selection process with the MDP – everyone is treated equally. A company can also plan for the MDP within their business operations. By creating an incentive to keep recycled HDPE within California, the MDP helps create a more sustainable recycling infrastructure in California.

2. High Virgin HDPE Prices and Demand

When the price of virgin HDPE is high, end-users have a stronger incentive to utilize recycled HDPE as a way to cut feedstock costs. In addition, reclaimers have a somewhat wider margin between bale price and pellet price, and are able to cover their operating costs. When reclaimers can sell their products for a higher price, they have more flexibility to purchase bales at a higher price. This makes reclaimers more competitive with China.

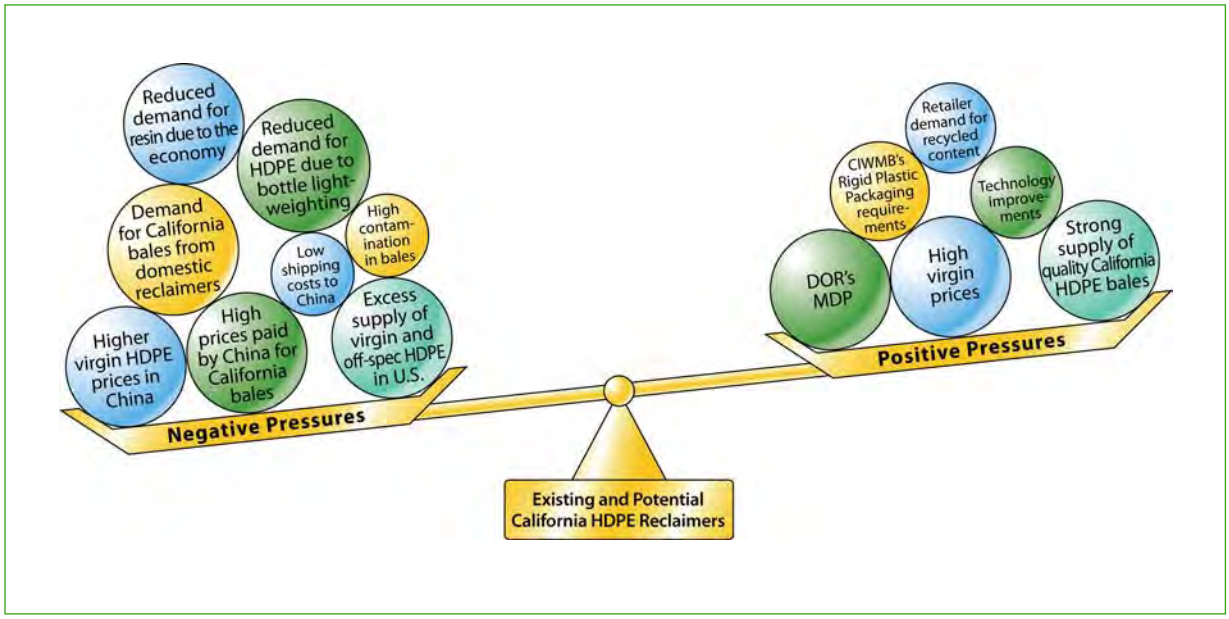
3. CIWMB's Rigid Plastic Packaging Containers (RPPC) Law

California's RPPC law requires most non-food plastic packaging containers sold within the State to: (1) be made from at least 25 percent postconsumer resin, (2) be source-reduced (light-weighted) by 10 percent, (3) be reused or refilled at least five times, or (4) achieve a 45 percent recycling rate if it is brand-specific or a particular type of RPPC. The RPPC law creates an incentive for product manufacturers to utilize recycled content in their packaging. However, the law is extremely difficult to enforce, and as a result the law does not provide as strong a market incentive as it could. The March 2009 *Plastic Recycling Update* reported that APR's executive director is meeting with the CIWMB to encourage enforcement of the RPPC law, stating, "the law is on the books, but isn't being enforced" (PRU, March 2009, p2).

4. Retailer Demand for Recycled Content and Sustainability

The increased interest in sustainability and green industry is creating a strong interest in the use of recycled plastic. Wal-Mart (through their sustainable packaging initiative) and Whole Foods are commonly cited as key drivers of retail use of recycled content materials. If a company that

Figure 5-7
Market Influences Affecting Existing and Potential California HDPE Reclaimers



utilizes plastic is seeking to reduce their carbon footprint, they will be looking for opportunities to light-weight containers, recycle, and use recycled plastic. In the longer term, industry's drive to reduce their carbon footprint should help increase domestic use of recycled materials.

If a company is truly trying to reduce their environmental impact, then it does not make environmental sense to ship recycled bales to China, process them with fewer environmental controls, and ship the recycled product or resin back to the United States. A sense of producer responsibility should take into account how the "green" materials that a company utilizes are handled. As one industry expert noted, "environmental stewardship does not stop when recycled beverage containers are shipped away in a crate."

5. Technology Improvements

There continue to be advancements in plastic sorting technology. Optical and infra-red technologies, reduced water use in washing, and other advancements can improve the quality of recycled feedstocks, and reduce the economic and environmental impact of handling recycled plastic. To be effective, these technologies need to be reliable and consistent.

A Nextek HDPE food-grade processing facility in London utilizes video and infrared scanners, pneumatic jets, two-stage washing, double-vacuum decontamination, and high-temperature processing and extrusion. Ongoing improvements in sorting technologies, particularly those that allow faster throughput, will continue to make domestic production of recycled HDPE more competitive.

6. Strong Supply of California HDPE Bales

Approximately fifteen (15) percent of all HDPE recycled within the United States comes from California. The Beverage Redemption Program creates a strong incentive to recycle CRV HDPE,

and the support the Program provides to curbside programs indirectly promotes recycling of non-CRV HDPE. While there is room for improvement in both the quality and quantity of HDPE collected in the State, California has a strong advantage over other parts of the country that do not have inclusive bottle deposit systems.

7. Role of Exports to the Pacific Rim

The fact that China is a dominant player in California's recycled materials markets also has positive implications. California is essentially an extension of the Pacific Rim. Export of significant portions of California plastic (and paper) to China creates somewhat of a paradox. On the one hand, the presence of the Chinese export markets keeps prices relatively high, and recycled material markets strong. Between California's strong waste management and recycling laws, and the ready-availability of Chinese markets, there is little chance that recycled materials in California will be sent to the landfill, as can occur in some parts of the country. When there is a healthy balance between exports and domestic use, the recycling system is strong, and all market players benefit. The difficult aspect comes in defining, and maintaining, a "healthy balance". Most in the industry would agree that California should have viable alternatives to utilize materials in-state (or at least domestically), and that export should not completely dominate recycled material markets.

D. New Market Alternatives and Opportunities

There are strong markets for recycled HDPE. The primary end-use for natural HDPE is non-food application bottles, such as for detergent, motor oil, and household cleaners. Envision is working on a grant to produce food-grade HDPE. The benefit of producing food-grade HDPE is that the recycled pellets will generate a higher price than non-food grade HDPE.

There are at least two companies already producing HDPE milk jugs with recycled content – South Africa based Nampak Plastics, and Nextek, located in London. Nampak has a London facility that processes 28 million pounds of recycled HDPE annually. Nampak has achieved a ten (10) percent recycled content level in milk jugs, and are targeting 30 percent by 2010. Nextek has produced food grade bottles with 100 percent recycled HDPE.

The primary end-uses for colored HDPE are lower-value products such as pipes, landscaping, and lawn and garden products. TRI/Environmental recently finished a study on the use of recycled HDPE in corrugated pipe for highway projects. TRI found that corrugated pipe made with 60 percent recycled HDPE met applicable highway standards and had a projected life of 50 years.

OMNI Resource Recovery, located in Colton, California, has received two DOR grants to produce corner boards for the California produce industry using recycled polypropylene and mixed color HDPE bales. This project should provide a viable local option for low value mixed color HDPE bales. A Denver-based manufacturer of plastic slip sheets, Repsco, received a DOR grant to relocate in Fresno, California. Repsco expects to utilize 10 million pounds of recycled HDPE annually.

The DOR has provided significant grant support to HDPE markets. Each of the three California HDPE reclaimers has received DOR grants to improve processes and capacity. Several California MRFs have received DOR grants to improve single stream sorting capability, in theory increasing the quality and quantity of HDPE. Two potential end-users have received DOR grants to produce new products in the State using recycled HDPE. The three reclaimers, and almost twenty (20) end-use manufacturers, received

market development payments to support their use of recycled HDPE in a range of products.

At this point, opportunities to improve markets for recycled HDPE should focus on addressing the severe market imbalance. If the current domination of China and Hong Kong in the HDPE export market was simply a matter of pure competition, it would be one thing. However, the domination of Chinese export markets is driven, in large part, by economic and policy subsidies provided to Chinese importers and manufacturers by the Chinese government.

The recycled material market crash in late 2008 illustrated the problem of heavy reliance on Chinese exports. When China stopped buying recycled plastic, recycled material essentially stopped moving. Prices dropped, and recyclers and processors, used to the inflated prices they had been receiving, were reluctant to sell material.

At the same time, California suspended the small subsidy (MDP) that was in place to help California compete with the Chinese market. The DOR cannot change international trade policies; however, the DOR can work to promote the use of California CRV material within the State.

DOR programs and funds provide significant support to curbside programs and recyclers, and the MDP and grant programs support reclaimers and end-users. However, there can be a disconnect between these two stages of the recycling process.

Processors and recyclers seek to sell their product (bales) for the highest price possible. This is understandable. Recyclers and processors are trying to recoup some of the losses they suffered when prices dropped dramatically late last year. In addition, many curbside programs are required, by contract, to seek the highest price for their bales. Some processors try to maintain a portion of their sales locally – with the intention of supporting the domestic infrastructure. Yet, if a broker can offer a processor 25 cents per pound to ship the material overseas, and a local reclaimer can only offer 20 cents per pound, how often can the processor chose the lower price? As several in the industry noted, customer loyalty seems to be suffering in these difficult economic times.[3]

The short-term economic interest of recyclers and processors may be harming the recycling infrastructure that the DOR has worked hard to support. Again, if this was a free-market dynamic, it would be easier to defend. However, curbside programs receive CRV payments, processing payments, quality incentive payments, and curbside payments from the DOR. Recyclers receive processing payments. The State is subsidizing recycling collection, but the way this material is ultimately handled is essentially undermining the existing recycling infrastructure.

The DOR could use existing, or new, payments to create incentives for processors and curbside programs to keep their materials in the State. For example, full payment of CRV, QIP, and/or curbside payments could hinge on the use of the material in California and/or domestic markets. The DOR could establish an additional MDP, so that certified processors, who currently receive only an administrative fee from the Program, could receive a MDP if they sold recycled material to California markets. This new MDP would link the current gap between recyclers and reclaimers. In addition, the State should reinstitute the existing MDP program, perhaps prioritizing it over some other DOR programs. The highest and best use of DOR grant monies, at least as they relate to HDPE, may be to shift funds to other programs that will support the recycling infrastructure that previous DOR grants have helped develop and/or improve.

[3] However, others in the industry commented that customers will stay loyal, even in difficult economic times, as long as customers are treated fairly, and quality is high.

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Section 6

Bi-Metal and Plastics #3 to #7

6. Bi-Metal and Plastics #3 to #7

The six (6) minority beverage container material types (bi-metal and plastics #3 to #7) are insignificant components of the AB 2020 program, and of recycled beverage container material markets. We address them in this section of the report, however, not with the same level of detail provided for the other four major CRV materials. In general, small quantities of these minority materials are generated, and even smaller quantities are recycled. Much of the recycling of bi-metal and plastics #3 to #7 occurs when they are mixed in with other more recyclable materials; bi-metal with tin cans, and plastics #3 to #7 with PET or HDPE. Often these minority materials are seen as contaminants in the process. **Table 6-1,** below, summarizes the Society of Plastics Industry resin identification system for plastics #1 to #7.

Table 6-1
Plastic Resin Types

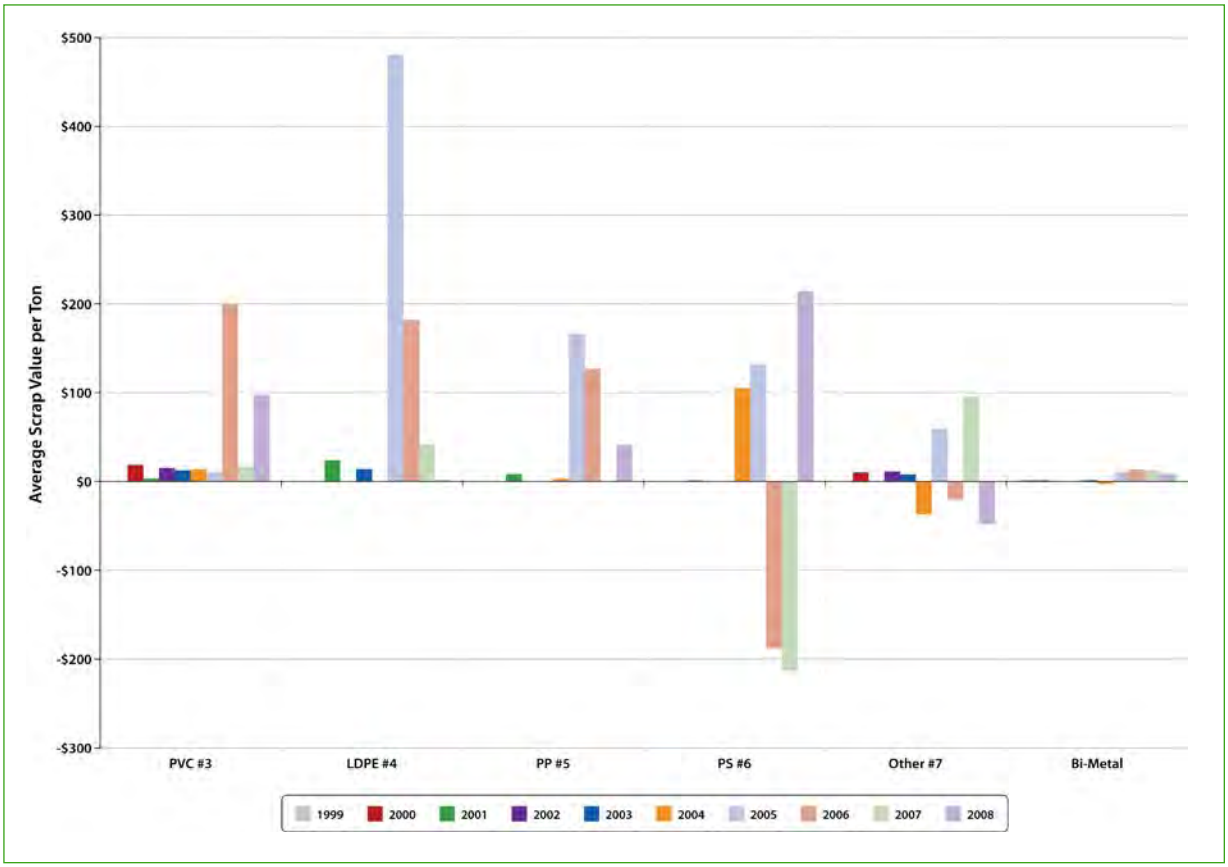
Plastic Resin	Abbreviation
Polyethylene terephthalate	PET #1
High density polyethylene	HDPE #2
Polyvinyl chloride (vinyl)	PVC #3
Low density polyethylene	LDPE #4
Polypropylene	PP #5
Polystyrene	PS #6
Other plastic resins/blended resins	Other #7

A. Material Flows and Market Players

Figure 6-1, on the next page, illustrates the low, and highly unstable, scrap prices for bi-metal and plastics #3 to #7. Over the last four years, the scrap value for bi-metal has been close to $10 per ton. The lowest bi-metal scrap value occurred in 2004, at negative $2.56 per ton, and the highest bi-metal scrap value occurred in 2006, at $13.74 per ton.

The average scrap value for PVC was around $10 to $15 per ton until 2006, when it skyrocketed to almost $200 per ton. The PVC scrap value dropped down to $17 per ton in 2007, and back up to $98 per ton in 2008. LDPE has shown similar variability, ranging between zero and $480 per ton. Similarly, PP has ranged from zero to $167 per ton, and PS has ranged from negative $213 to positive $214 per ton over the last ten years. Other #7 plastic has had a slightly smaller range, reaching a low of negative $48 per ton, and a high of $96 per ton. It is important to keep in mind, as we discuss below, that these scrap values are based on the extremely low volume of these materials that are recycled in California.

Figure 6-1
Plastics #3 to #7 and Bi-Metal Average Scrap Values (1999 to 2008)



Nationally, less than four percent of all plastic bottles made, and less than one percent of all plastic bottles recycled, use plastic resins #3 through #7. At the national level, the most common bottle type purchased and recycled among plastic resins #3 to #7 is polypropylene (PP #5).

Table 6-2, on the next page, provides a comparison of the number of containers sold and recycled, and the percent of containers sold and recycled, for each of the ten material types in California. This table clearly illustrates the minimal role that bi-metal and plastics #3 to #7 play in the beverage recycling program. The most common of these materials, PS #6 and plastics Other #7 each make up only 0.2 percent of beverage container sales. On average, each person in California buys only 3.6 bi-metal and plastic #3 to #7 CRV containers per year. The least common beverage container is PVC #3, with less than one million CRV containers sold per year, only 0.004 percent of beverage container sales. The least commonly recycled container types are LDPE #4 and PP #5. There were only 14,277 LDPE containers recycled statewide in 2008, and only 13,082 PP containers recycled statewide in 2008.

Figures 6-2 through 6-7, on the pages that follow, provide the CRV sales and recycling for each of the materials. Note that the scales for recycling rates and number of containers differ for each exhibit.

It is very likely that these recycling figures are missing a significant number of plastic #3 to #7 containers that are recycled with HDPE. While

Table 6-2
Comparison of Sales and Recycling By Material Type (2008)

Material	Sales (Number of Containers)	Percent of Sales	Recycling (Number of Containers)	Percent of Recycling
1. Aluminum	9,539,853,194	43.5%	8,004,343,688	49.5%
2. Glass	3,339,106,477	15.2%	2,523,961,411	15.6%
3. PET #1	8,603,054,451	39.2%	5,322,655,474	32.9%
4. HDPE #2	340,429,976	1.6%	311,121,660	1.9%
5. PVC #3	948,340	0.004%	78,331	0.0005%
6. LDPE #4	8,828,872	0.04%	14,277	0.0001%
7. PP #5	1,709,379	0.01%	13,082	0.0001%
8. PS #6	51,728,106	0.2%	607,646	0.004%
9. Other #7	35,934,816	0.2%	2,427,064	0.02%
10. Bi-Metal	31,632,517	0.1%	4,306,700	0.03%
Total	21,953,226,128	100.0%	16,169,529,333	100.0%
Total of Bi-Metal and Plastics #3 to #7	130,782,030	0.6%	7,447,100	**0.05%**

recyclers accept plastic #3 to #7, very few recyclers actually report plastics #3 to #7 containers to the DOR. It is common practice among recyclers to mix the small number of plastic #3 to #7 containers that they receive in with HDPE. This practice likely increases the HDPE recycling rate, and reduces the plastic #3 to #7 recycling rates.

Recycling rates for bi-metal, shown in **Figure 6-2,** on the next page, are higher than for plastics #3 to #7, however they are still far below the four major CRV materials. In 2008, the bi-metal recycling rate was just below 4 percent. Sales of bi-metal CRV containers increased significantly when new containers were added to the program in 2000, however, they have dropped each year since 2003. There were 55 processors that handled bi-metal during 2008. The amount of bi-metal that processors reported for the year ranged from less than 15 pounds, to almost 200,000 pounds.

Figure 6-3, on the next page, illustrates the drop in polyvinyl chloride (PVC) sales after 2002. There are several factors that could have contributed to this decline. PVC and PET are somewhat interchangeable as a beverage container, and PET is far easier to recycle. The material-specific processing fee for PVC, significantly higher than the PET processing fee, went into place in 2004, and may have caused some beverage manufacturers to switch away from PVC containers for their products. Furthermore, the use of PVC for beverage containers has been criticized because it is a contaminant in the PET recycling stream. This PVC sales trend has reversed somewhat over the last two years, but PVC sales are still far below 2002 levels. As sales of PVC increased in 2007 and 2008, the recycling rate decreased.

PVC can be recycled, and there are a number of companies that recycle this material, although the emphasis is not on PVC bottle recycling. Only twelve (12) processors handled PVC in 2008, and seven of those processors reported less than ten (10) pounds for the year. One processor, IMS Recycling Services, handled the vast majority of all PVC recycled.

Figure 6-4, on page 6-5, illustrates recycling and sales for low density polyethylene (LDPE). LDPE

Figure 6-2
Bi-Metal Beverage Containers Sold and Recycled (1990 to 2008)

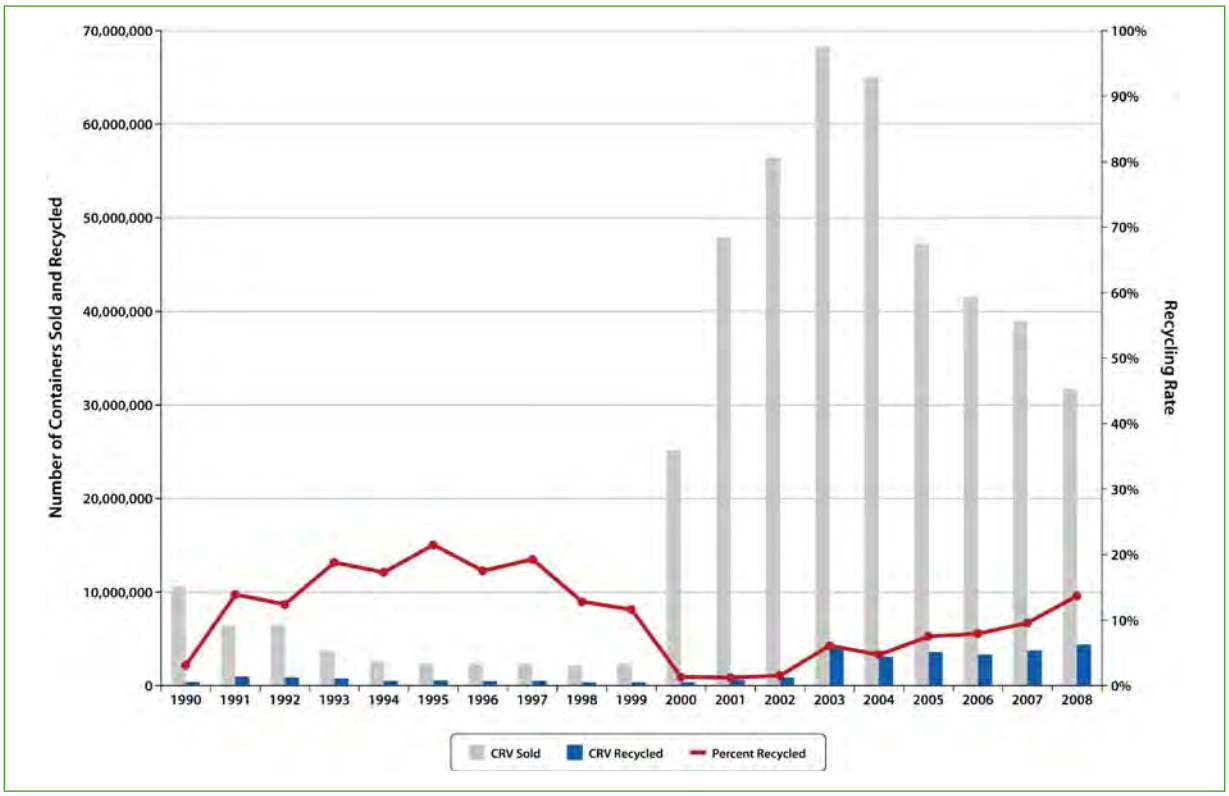


Figure 6-3
PVC #3 Beverage Containers Sold and Recycled (2000 to 2008)

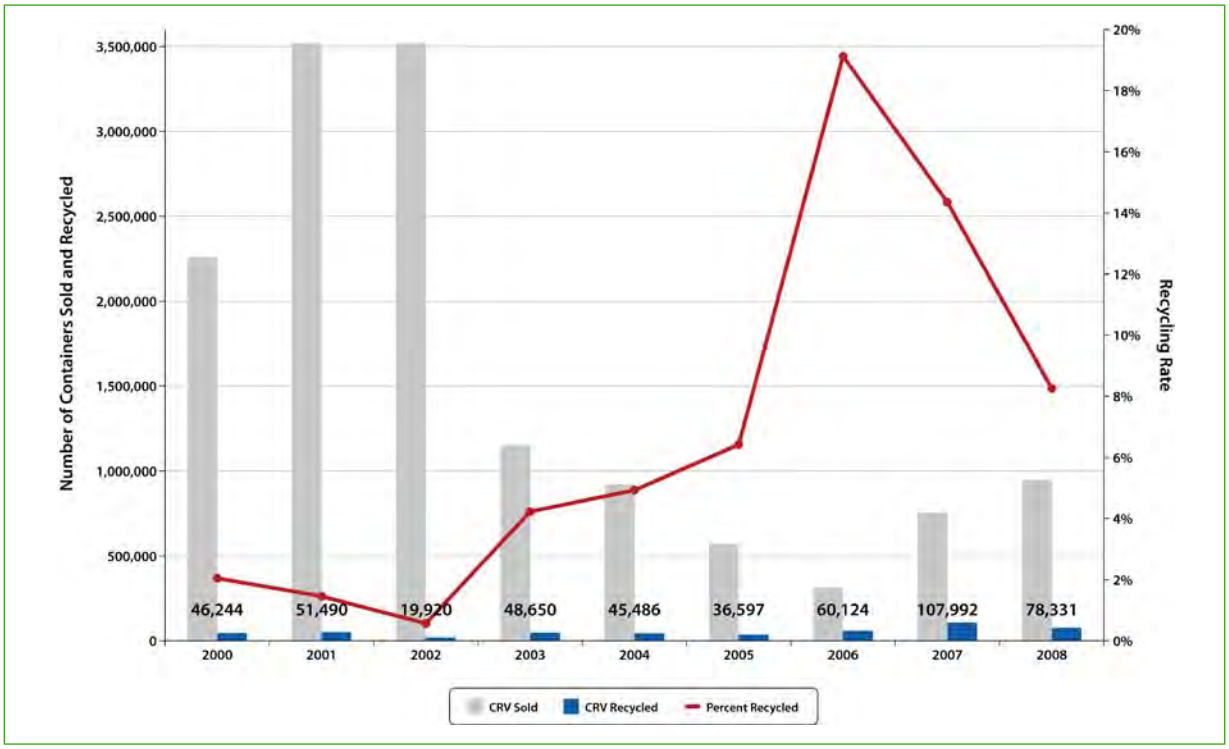
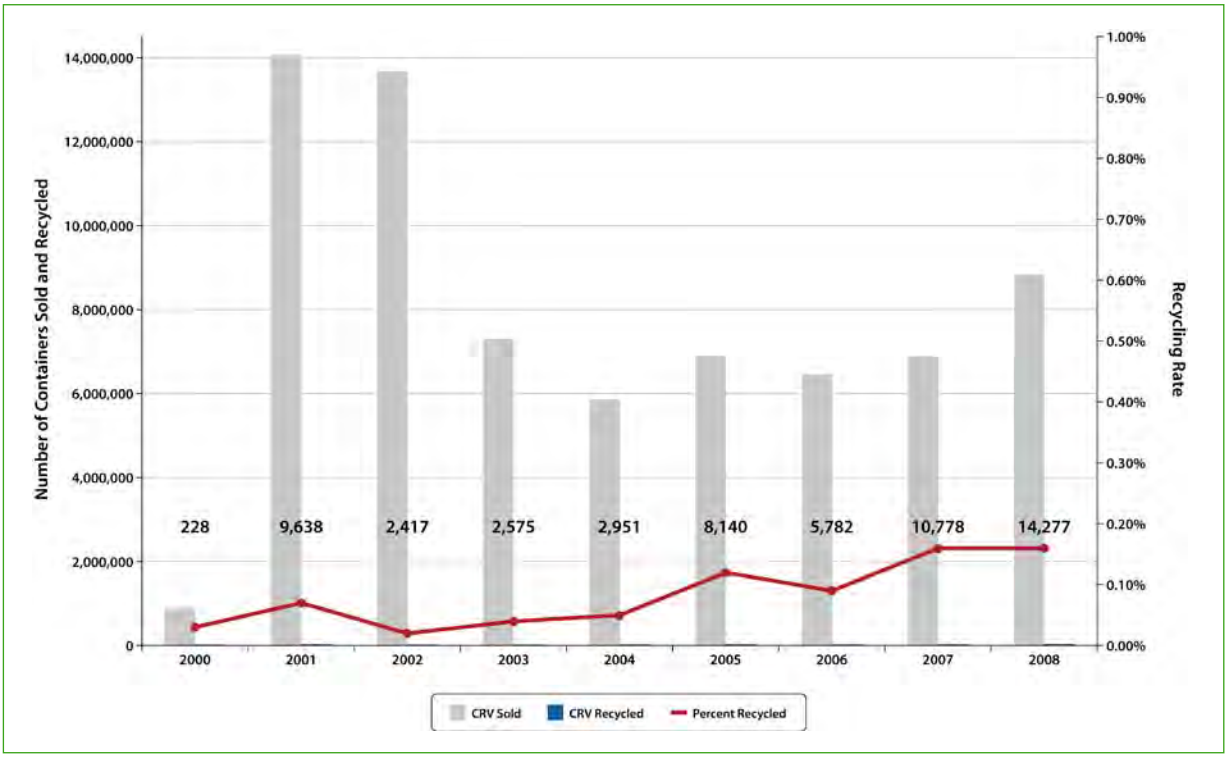


Figure 6-4
LDPE #4 Beverage Containers Sold and Recycled (2000 to 2008)



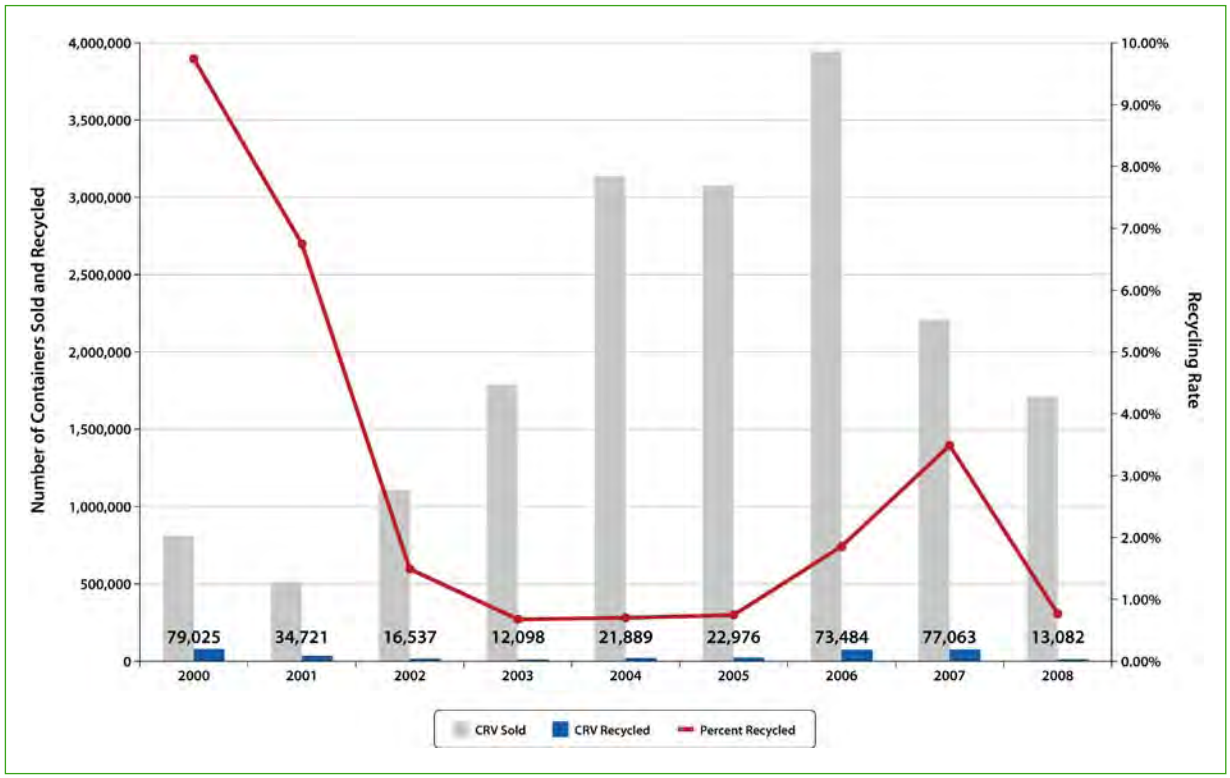
recycling is almost non-existent, with only 14,277 LDPE containers recycled in 2008. Only eighteen (18) processors handled LDPE in 2008, and ten (10) of those handled less than 10 pounds during the year. The largest volume of LDPE that any processor reported was 88 pounds.

Figure 6-5, on the next page, illustrates sales and recycling for polypropylene (PP). Sales of PP containers declined in 2007 and 2008. In 2008, only 13,082 PP containers were recycled. Similar to LDPE, only eighteen (18) processor handled PP in 2008, and ten (10) of those processors handled less than 10 pounds during the year. IMS Recycling Services reported significantly more PP volume than any other processor.

Much of the PP that is recycled is not beverage containers, but beverage container caps. Caps for PET soda and water bottles are typically made of PP. Omni Resource Recovery received two DOC grants to establish a processing line and sink-float system that will allow the company to produce PP/HDPE angle boards for boxes used by the produce industry. As much as fifteen (15) percent of a PET bales is composed of PP caps and labels. Thus, the 57 million pounds of PET reclaimed in California in 2008 could provide over eight (8) million pounds of PP. Omni will purchase this material, along with colored HDPE, to produce the angle boards. Although Omni could utilize PP bottles, there are not enough bottles recycled at this time.

HDPE reclaimer Talco Plastics recently completed a DOC grant that allows the company to optically sort PP and PET contaminants from HDPE bales. There are a number of potential markets for PP, including consumer goods, medical products, bottles, and spouts for detergent bottles. Again, much of the PP will be in the form of caps and labels, although there are likely some PP bottles mixed into the HDPE bales.

Figure 6-5
PP #5 Beverage Containers Sold and Recycled (2000 to 2008)



KW Plastics of Alabama has bought baled loads of PP from California, although likely only a small share of this material is CRV. KW utilizes PP in paint pails, and would utilize more if it were available. In general, industry analysts report an increased demand for recycled PP.

Figure 6-6, on the next page, illustrates sales and recycling for polystyrene (PS). PS sales increased in 2008. The number of PS CRV containers sold is greater than all other plastic #3 to #7 containers sold, combined. However, PS has limited applications as a beverage container, and is generally only used in the form of a foil-topped cup for juice. Recycling of PS has increased, although it is still extremely low. There were 21 processors that handled PS in 2008, with seven handling less than 10 pounds of PS during the year.

Figure 6-7, on the next page, illustrates sales and recycling for other plastics (#7). This plastic resin category is not a specific resin type, but typically includes plastic beverage containers made out of more than one resin type blended together, or containers that include an additional barrier layer. Sales of beverage containers in Other #7 plastic have decreased since 2006. The recycling rate of Other #7 plastic has increased since 2006, and is just over six (6) percent. There were 48 processors that handled Other #7 plastic during 2008, far more than for any of the plastics #3 to #6. The amount of Other #7 plastic that these processors handled ranged from 40 pounds to over 71,000 pounds during the year.

B. Current Market Dynamics

There are limited quantities, and limited markets, for the minority materials. Bi-metal is typically recycled with tin or steel. Because there is so little bi-metal recycled, the bi-metal bin is

Figure 6-6
PS #6 Beverage Containers Sold and Recycled (2000 to 2008)

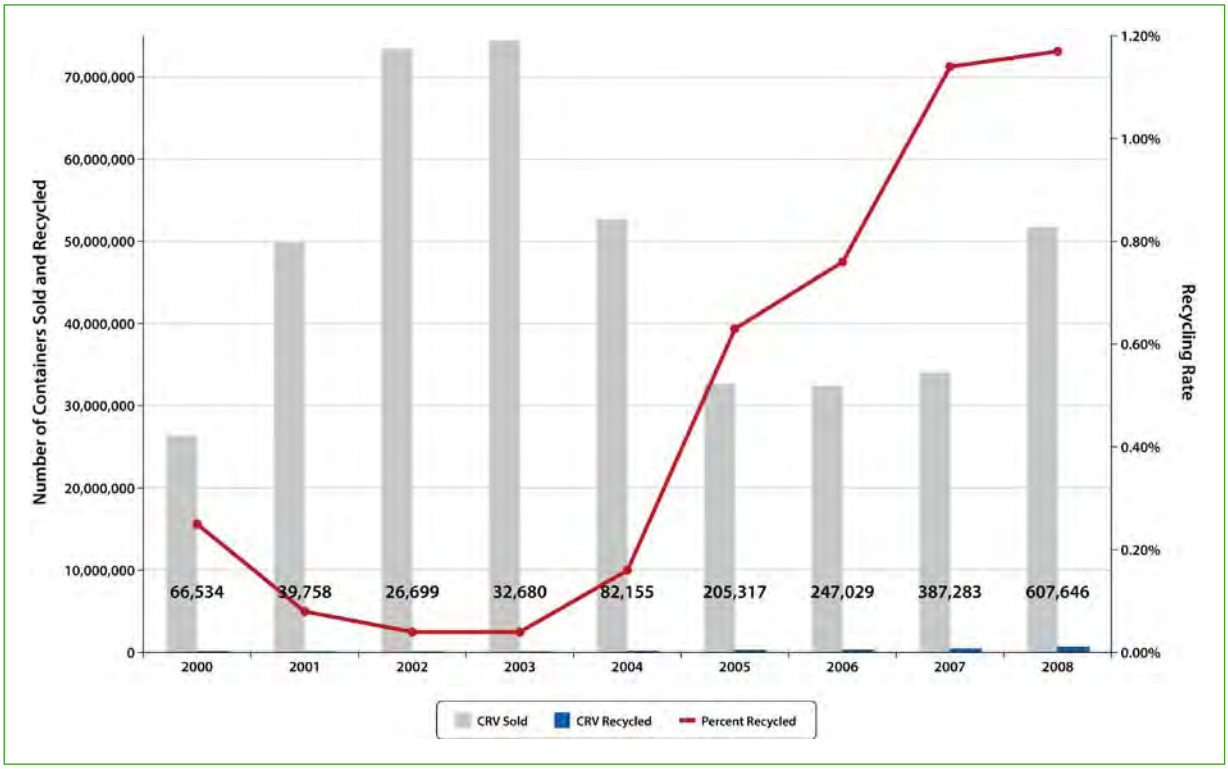
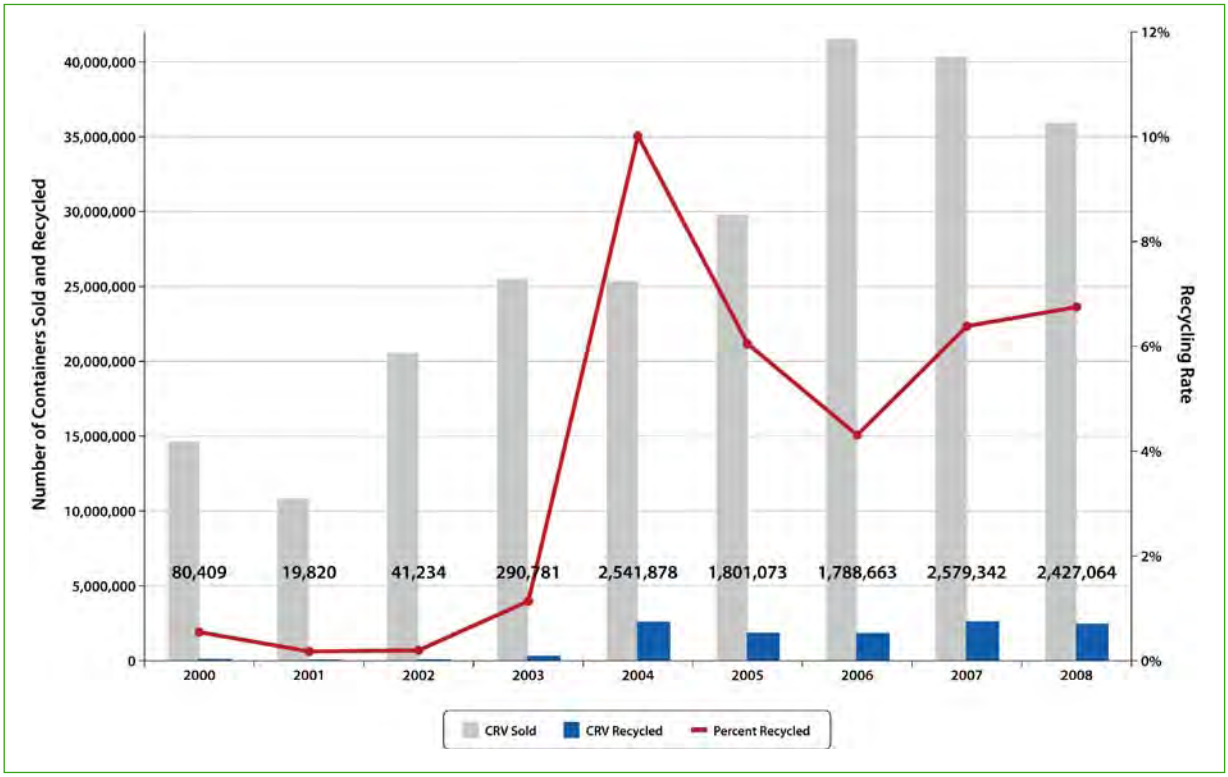


Figure 6-7
Other #7 Beverage Containers Sold and Recycled (2000 to 2008)



often a catch-all for a mix of containers (such as the PET/aluminum container) and garbage.

Much of the plastics #3 to #7 is recycled as a byproduct of HDPE and/or PET recycling. Mixed color bales of HDPE may contain up to 35 percent of plastics #3 to #7 and colored PET. While these materials are generally not counted as being recycled, there may actually be more plastics #3 to #7 recycled with HDPE than directly through buyback programs.

All three HDPE reclaimers in California are working to remove the minority plastic materials, and in some cases use them. Epic Plastics can utilize all plastics except PVC and PET in their products. Although contamination rates may be higher, typically 15 percent to 25 percent of a mixed bale of HDPE consists of plastics #3 to #7 and PET. Thus, for every 1,100 pound bale, up to 275 pounds are plastics #3 to #7 or PET. There is no CRV paid on these materials, as they are considered contaminants in HDPE bales. Epic utilizes all plastics #4 to #7 in their products.

There is also incidental plastics #2 to #7 in PET bales. Guangyi Group buys as much as seven (7) million pounds per month of PET bales. Given these quantities, the amount of non-PET plastic may be significant, even at low contamination rates. Guangyi Group sorts these non-PET plastics at their facility in Southern California, flakes the material, and exports it to China with the PET. In China, the plastic is sold to factories located near Guangyi's Chinese fiber plant that utilize the material. Again, this plastic is not "counted" as recycled, as it is a contaminant in PET bales.

Plastics #7 is the only one of the minority plastics that is recycled in noticeable quantities, although the volumes are still minimal. The majority of #7 plastic consists of Langer's juice bottles, which are made of predominantly PP. These bottles can be baled and recycled as PP, and purchased by end-users such as KW Plastics.

C. Market Influences

The key market issue for bi-metal and plastics #3 to #7 is lack of material. This lack of material is not particularly a problem, as these materials also have little demand, and little value.

D. New Market Alternatives and Opportunities

A variety of products can be made from plastics #3 to #7, either as single resin streams or mixed. PVC generally must be separated from the other resins prior to end-use. A number of products can be made from mixed plastics #4 to #7, although many require some higher percentage of HDPE in the mix.

There are always new alternatives being identified for mixed plastic, for example an Ohio company, Polyflow, has developed a process to convert plastic and rubber scrap into feedstock chemicals. The process will utilize 80 percent polyethylene, PP, and PS, in equal parts, and 20 percent rubber, nylon, or other specialty plastics. Many of the alternatives for mixed plastics material are directed towards utilizing recycled film plastic, rather than utilizing recycled containers.

The DOR has provided grants for plastic optical sorting technologies to several companies. These technologies improve the quality of the primary plastic stream – PET or HDPE – while generating a secondary plastic stream – plastics #3 to #7. While there are opportunities to develop end-products for these minority plastic materials, the DOR should continue to maintain their focus on PET and HDPE.

There is simply not enough volume of plastics #3 to #7 to warrant significant investment of State resources. Just because there are products that can be made from mixed or single resin plastics #3 to #7, this does not mean that the DOR should spend their limited resources on these materials. Similarly, given what little bi-metal is recycled in California and is processed with tin cans, there is no need to invest State funds in bi-metal market development.

Section 7

Factors and Trends Affecting Recycling

7. Factors and Trends Affecting Recycling

The previous report sections examined the specifics and complexities of recycling markets for each of the ten beverage container material types, focusing on aluminum, glass, PET, and HDPE. Each material operates within a unique market structure. At the same time, there are broader economic, business, environmental, and social factors that influence recycling, and recycled material markets, more generally. In this final report section we discuss two types of factors that influence recycling markets for all materials: (1) general factors influencing recycled material markets; and (2) trends in beverage markets and beverage containers. This chapter does not provide a treatise of these subjects, but rather a brief introduction to these topics that are peripherally related to recycled beverage container material markets. The length of this chapter is not indicative of the overall importance of these topics.

A. General Factors Influencing Recycled Material Markets

There are numerous overlaying factors that influence California's recycled beverage container material markets. These factors influence markets, and market players, both positively and negatively. Below, we discuss one negative, and three positive influences. The immediate negative impact of the global economic downturn may overshadow potential positive market influences. However, we believe that in the long-term, the positive market influences bode well for recycling and recycled material markets.

1. The Global Economic Downturn

Recycling has not been immune to the global economic downturn of the last year, and many would say that recycling and trash generation are bellwethers of our general economic status. A recent article in *Waste & Recycling News* started as follows: "Forget Wall Street analysts and cable news talking heads. If you want to know when the nation starts pulling out of the recession, maybe you should ask your local scrap guy" (Waste & Recycling News, May 4, 2009). Although it is not quite that simple, the concept that scrap, trash, and recycling industries are a reflection of what is going on in the larger economy is definitely real. When more products are being consumed, more products and packaging are being recycled and thrown away – and vice versa.

Recycled beverage container materials are global commodities. Prices for recycled aluminum and recycled plastic are inextricably linked to prices for primary aluminum and virgin plastic, and the international trade policies and dynamics that shape commodity markets. Just as oil pricing drives much of our overall economy, the price of a barrel of oil affects not only the transportation of recycled materials, but the entire pricing

Table 7-1
Comparison of Recent Average Recycled Material Prices in California and Nevada, Delivered

Material	Week of April 30, 2009 Average	Four Year Average (April 2005 through April 2009)	Lowest Average Weekly Price (2008 or 2009)	Highest Average Weekly Price (2008)
Aluminum cans, baled	41 cents/pound	75 cents/pound	39 cents/pound	89 cents/pound
PET, baled	18 cents/pound	21 cents/pound	5 cents/pound	30 cents/pound
Natural HDPE, baled	21 cents/pound	30 cents/pound	9 cents/pound	40 cents/pound
Colored HDPE, baled	13 cents/pound	20 cents/pound	3 cents/pound	37 cents/pound
Flint Glass	28 dollars/ton	33 dollars/ ton	28 dollars/ ton	45 dollars/ ton
Amber Glass	18 dollars/ ton	19 dollars/ton	18 dollars/ ton	20 dollars/ ton
Green Glass	7 dollars/ ton	8 dollars/ton	11 dollars/ ton	7 dollars/ ton

Source: Waste & Recycling News, Secondary Materials Pricing

structure of plastic resins. International trade policies may seem a long way from a neighborhood recycling facility, but they can influence prices that recyclers receive for recycled beverage container materials.

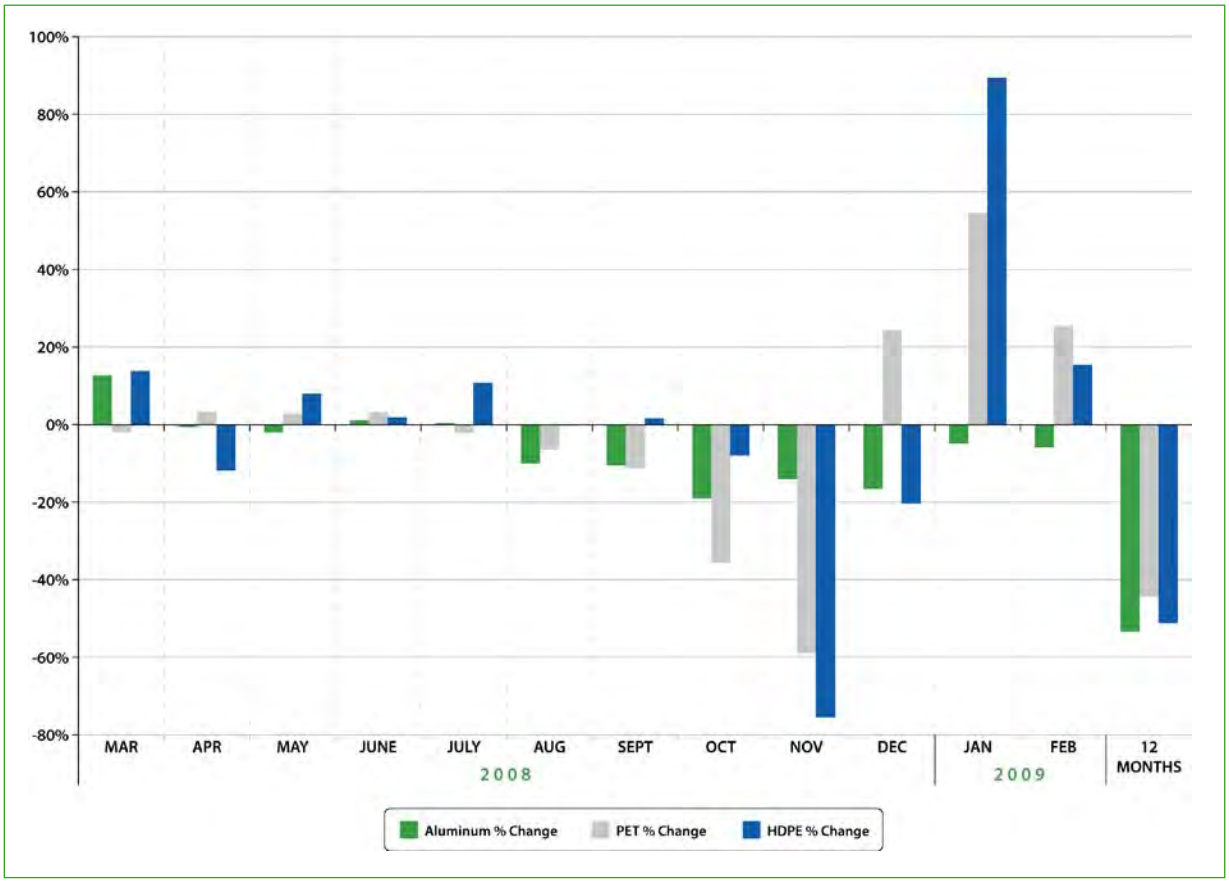
Overall, the economic downturn has had a major destabilizing influence on recycled material markets. Reductions in demand for automobiles, housing, and consumer goods affect demand for many materials, including primary and recycled aluminum, and virgin and recycled plastics. Tightening of credit markets negatively affect players at all levels of industry. Tight credit markets make it more difficult to buy and sell materials, and make it more difficult, or risky, to invest in new technologies to use recycled material. In addition, companies selling recycled materials are waiting longer to receive payment. Conversely companies buying recycled materials are finding it harder to make payments, or to make them on time. The result is a general climate of risk aversion.

When demand for consumer goods declined in late 2008, manufacturers worldwide were left with large inventories of raw materials – including both primary and recycled materials. Demand for raw materials, including recycled materials, dropped – and so did prices. While the recycling industry is (or should be) used to the cyclical nature of pricing, the rapidity of price and demand drops for recycled materials in late 2008 surprised most in the industry.

George Adams of the Institute for Scrap Recycling Industries (ISRI) commented, "we all knew the market's bull run would eventually end, but no one anticipated the precipitous drop in demand and prices that hit our industry beginning last fall" (Scrap, January/February 2009, p.7). There are normal supply and demand cycles in the industry every seven to ten years, but the drop in 2008 was faster and sharper than "normal". Many recyclers reacted by storing materials for longer periods of time – to essentially wait until prices increased again. Not all recyclers followed that prescription, with one California recycler noting that a good relationship with buyers and a clean product could allow recyclers to keep material moving, even in a down market (albeit at lower prices).

Pricing for recycled materials have recovered somewhat from late 2008. However, current prices are far below the previous historic high levels of mid- 2008. **Table 7-1,** above, compares prices for various recycled materials at April 30, 2009, with the four year average, recent low, and the recent peak. It is worth noting that recycled material prices were at fairly high levels, from a historical perspective, during 2005 to 2008.

Figure 7-1
Percent Change in Monthly Average Scrap Values for Aluminum, PET, and HDPE (March 2008 to February 2009)



Further illustrating the volatility in recycled material prices over the last year, **Figure 7-1,** above, provides the percent change by month, from February 2008 to February 2009, for monthly average scrap prices for aluminum, PET, and HDPE. The aluminum price is from the American Metals Market, while the PET and HDPE prices are from the DOR's monthly survey of processors. Over the twelve month period, average prices for these materials dropped between 44 and 53 percent.

Baled aluminum can prices in late April 2009 appeared to be inching upward from the lows of the beginning of 2009. However, at 41 cents per pound, baled aluminum prices were still well below previous levels. PET prices are now relatively close the average price over the last four years. HDPE prices are still well below the average price over the last four years.

Glass, which is based on a more regional market structure, and the less volatile price structure of raw materials such as sand, limestone, and soda ash, has been far less affected by the economic downturn. However, in early 2009, prices for glass cullet were at the lowest levels seen in the last four years.

At a statewide level, California's budget crisis has created an additional layer of uncertainty and instability. While California can be a challenging place to do business in good times, the State's budget crisis places additional strain on California industries. Within the recycling industry, this strain is reflected and further amplified by the suspension of a number of Division of Recycling programs.

2. Green Building Movement and the Economic Stimulus Package

The green building movement is creating increased interest in building materials that contain recycled content. Green building, which already had significant momentum on its own, is receiving an additional boost from the federal economic stimulus package.

The $789 billion stimulus bill (called the American Recovery and Reinvestment Act of 2009) includes billions of dollars in infrastructure projects that could utilize significant quantities of recycled materials, and/or benefit the country's recycling infrastructure. A recent article in Resource Recycling (March 2009), identifies several "shovel ready" projects that directly benefit recycling, and notes that rebuilding the energy grid, as well as transportation infrastructure, will use large amounts of recycled materials. While most of these large-scale projects will not utilize recycled beverage containers, there is some potential to increase the use of recycled materials – most likely glass and plastic, in building projects.

Green building efforts in the U.S. are led by the U.S. Green Building Council, through the Leadership in Energy and Environmental Design (LEED) certification system. One category of the LEED green building certification system is materials and resources. Under the LEED system, use of recycled materials in building projects adds points toward a project's overall LEED certification.

Green building efforts are being promoted, or required, at the federal, state, and local level. The State of California passed a California Green Building Standards Code in July 2008. This code addresses reducing water and energy use in buildings through landscaping, appliance efficiency, building design, and the use of recycled materials. The code is voluntary through 2009, and then becomes mandatory. As of February 2009, fifty California cities and counties have passed green building ordinances or resolutions. Many of these require municipal and or commercial (sometimes residential) buildings (sometimes over a certain size) to meet Silver LEED status, provide permit incentives for LEED certified projects, or provide expedited permits for LEED certified projects.

3. Climate Change

Over the last several years, there has been an increased recognition across industry, government, and consumers that "climate change is happening, and [that] it is linked directly to human activities that emit greenhouse gasses" (Pew Center on Global Climate Change, January 2009, p.1). The result has been a strong response from industry to reduce greenhouse gas emissions. This response is a significant shift from the 1990s, when most companies were opposed to greenhouse gas controls. Now, many large Fortune 500 companies are taking the lead on greenhouse gas reductions, and pushing for more government control. As a metric, companies are looking to reduce their carbon footprint[1], a concept that was barely recognized ten years ago.

While the biggest gains in reduction of greenhouse gases are in the energy and transportation sectors, recycling and the use of recycled content reduces energy use, and thus greenhouse gas emissions. Thus, as companies are looking at all options to reduce their carbon footprint, there is an increased focus on recycling, and the use of those recycled materials in products. In addition, companies are light-weighting containers and packaging, reducing the overall amount of packaging. These alternatives reduce material use, as well as transportation costs. Companies also are recognizing the fuel and economic benefits of minimizing transportation through more local use of raw materials and end products.

[1] Carbon footprint is defined as the total set of greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event, or product (UK Carbon Trust 2008). It is typically measured in tonnes or kilograms of carbon dioxide equivalents.

With the passage of AB 32, the California Global Warming Solutions Act of 2006, California has been at the forefront of the climate change issue. AB 32 requires that California reduce greenhouse gas emissions to 1990 levels by 2020. AB 32 implementation is led by the California Air Resources Board (ARB). After a lengthy public input process, the ARB released the Climate Change Scoping Plan in December 2008. The plan "proposes a comprehensive set of actions designed to reduce overall greenhouse gas emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, create new jobs, and enhance public health" (ARB, December 2008, p.ES-1).

4. Sustainability and Green Packaging

The current green movement, and push toward sustainable packaging, is driven in large part by Wal-Mart, Whole Foods, and other large companies that are seeking to reduce their environmental impacts. Driven by concerns about climate change, there is a significant shift by industry toward incorporating sustainability into business operations. After many years of gradually moving in the direction of sustainability, sustainability concepts have become mainstream. While there are concerns that some companies are more interested in marketing benefits than true environmental benefits, there is a general consensus that the green movement is real, and is here to stay.

Several quotes by industry representatives reflect this sentiment. For example, Kim Jeffery, CEO of Nestlé Waters North America, is a leader in sustainability efforts among beverage manufacturers.[2] At a conference in June 2008, Mr. Jeffery stated: "My job as a CEO, father of four, and citizen is to help direct the resources of this company to higher levels of sustainability. Think broadly about what sustainability means and what you can do to leave the world as well off, if not better. Measure and understand your impacts along the whole value chain, not just what you directly control. Get outside your four walls and work with stakeholders to test goals and to measure them. You have to think about sustainability as a continuous process, a journey, not a destination" (Plastic News, July 7, 2008, p.1). Specifically about plastic, Mr. Jeffery stated: "Every company that uses plastics in its packaging has a responsibility to push for comprehensive initiatives to really move the needle on recycling. It is not about using [plastic containers] it is about getting them back" (Plastics News, July 7, 2008, p.1).

At a Sustainability in Plastics conference in fall 2008, several speakers touched on the importance of sustainability. Larry Wendling, staff vice-president of corporate research at 3M Company said, "we see sustainability as a business opportunity, but consumers and retailers are demanding green-based materials with the same or better properties at the same price, so you need to use innovations to achieve a practical outcome, combining customer and market needs." Ron Pernick, founder of materials and technology company Clean Edge, Inc. warned firms to "embrace long-term thinking, long-term thinking is critical. Either be part of one of the greatest shifts in business and economic history, or become extinct" (Plastics News, October 6, 2008, p.1).

Companies are examining the environmental impacts of the products along the value chain. Examples include Wal-Mart's sustainability scorecard, and Nestlé Waters. Kim Jeffery stated, "You have to look at the impact of sustainability up and down your value chain. Our company is responsible for not only what goes on in our four walls, but what happens at the end of life and for the

[2] However, in May 2009, Nestlé Waters North America, Polar Corp., and the International Bottled Water Association filed a lawsuit against the State of New York's expanded bottle bill, calling it unfair and unconstitutional.

actions of everyone [else] in the value chain. You have to build a corporate culture where everyone is encouraged to make sustainable decisions. The best thing you can do is make smart long-term investments on sustainability. Your company will be better positioned in the long-term" (Plastics News, December 8, 2008, p.15).

Yet another perspective, from David Luttenberger, of Packaging Strategies magazine, noted that, "When you put sustainability in terms of process efficiency, it means lower costs and greater margins. While everyone likes the social equity, right now what's really pushing the sustainability initiative forward is that people are looking at ways to reexamine everything they do and finding more efficient ways to do it. You have to look at every way you can grow that bottom line" (Plastics News, April 6, 2009, p.11).

A group of packaging executives at an October 2008 Sustainability Packaging Forum from companies such as Kellogg, Frito-Lay, and Sara Lee agreed that sustainability has become mainstream, and that companies need to adopt sustainability as an integral part of their operations, and the operations of companies in their supply chain.

While companies appear to be moving in the direction of increased sustainability, in many cases, there is a long way to go. In general, there is a history of rhetoric versus action. A San Francisco based environmental investment group conducts a beverage company scorecard. The highest grades of 23 companies was a C, for Coca Cola, followed by Anheuser-Busch, Pepsi, and Nestlé Waters with grades of C-.

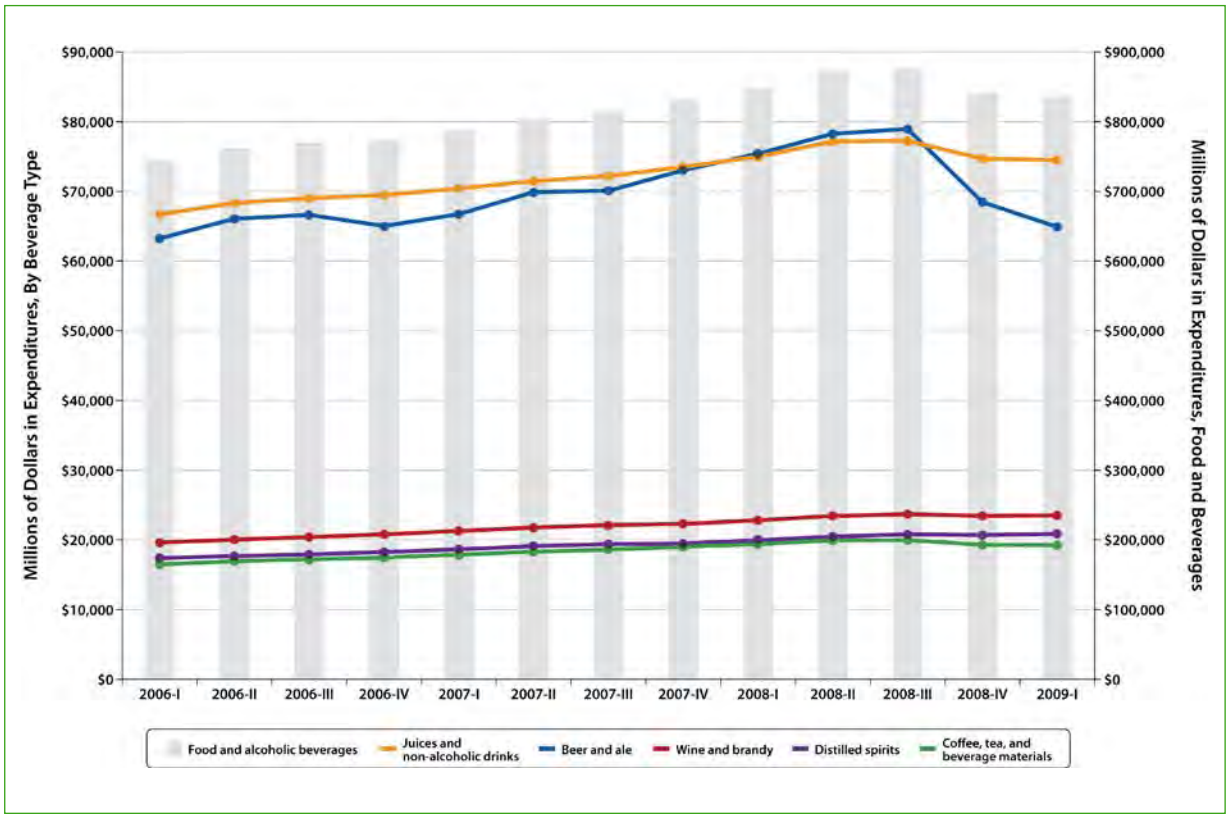
Highlighting the importance of the link between environment and economics, one industry source said, "recycled content sustainability packaging initiatives go out the window when people can get bargains on virgin resin, at some point, if this industry is to survive, people have to take a long-term approach, commit to recycled content and leave some of these deals on virgin on the table" (Plastics News, December 8, 2008, p.4). This comment points to a key problem, particularly for plastics. With very few exceptions, the beverage industry has not supported real steps to increase recycled content in plastic bottles. What is technically feasible – as much as 50 percent – versus what is actually utilized – zero to ten percent – are far apart.

While California is far from implementing new programs, the green/sustainability movement has created a resurgent interest in extended producer responsibility, or product stewardship efforts. The Beverage Container Recycling Program is essentially already a product stewardship approach to managing the life cycle of beverage containers. Legislation currently being considered in the State during the 2009-2010 legislative session includes the California Product Stewardship Act of 2009 (AB 283, Chesbro). This bill would require the California Integrated Waste Management Board (CIWMB) to work with other state agencies, including the DOC, to adopt an "Extended Producer Responsibility Framework" to reduce end-of-life environmental impacts of products. The intent is that the CIWMB would implement a flexible approach for products, starting with those with the largest management and environmental impacts. Implementation of a broader environmental stewardship system in California, and/or addition of beverage containers to the Beverage Container Recycling Program, if they were to occur, would impact recycling and recycled material markets.

B. Trends in Beverage Markets and Beverage Containers

The beverage containers that consumers purchase make their way through the recycling system, affecting collection, processing, and final end-use opportunities. In this section, we examine

Figure 7-2
Bureau of Economic Analysis – Quarterly Personal Consumption Expenditures (2006 to 2009)*



*All purchases for off-premises (i.e., at home) consumption

recent trends in liquid beverage markets. Beverage trends are influenced by consumer preferences, marketing, and the broader economy, among other factors.

Demand for durable goods suffers more significantly in an economic downturn; however, the current economic crisis has impacted non-durable goods such as packaging. Changes in the food packaging industry include fewer new product introductions, increased efficiency, increased private label (store brand) sales, and lower drink sales on-premises.

Sales data from late 2008 and early 2009 are showing reductions in sales of many beverages and/or container types, as a result of the economic downturn. **Figure 7-2,** above, illustrates U.S. expenditures on off-premises (at home) consumption of food and various beverages from the first quarter of 2006, through the first quarter of 2009. The overall expenditures for food and beverages are shown in the bar graph, using the right hand axis. The bar graph shows a gradual increase in expenditures until the fourth quarter of 2008, and first quarter of 2009. There was a 1.4 percent decline in overall food and beverage expenditures between the first quarter of 2008, and the first quarter of 2009.

Expenditures by beverage category are shown in Figure 7-2 as lines, using the left hand axis. Every single category showed a decline from the third to fourth quarters of 2008. With the

Table 7-2
Summary of Beverage Industry Trends and Impacts on Recycling and Recycled Material Markets

Beverage Industry Trend	Potential Impact on Recycling and Recycled Material Markets
1. New introductions and increased consumption of beverages with a health/wellness focus and functionality focus, such as caffeinated energy drinks	More packaging innovations, new and different types of packaging. To the extent that new packaging is made of blends or less recyclable materials, there may be negative impacts on recycling and/or recycled material quality
2. Carbonated soft drinks continue to lose market share to all other beverage types	Less "standard" packaging – i.e. 12 ounce aluminum cans and PET soda bottles in the recycling stream
3. Continued diversification of aluminum containers – "suddenly aluminum is hip" – continued growth in sleek cans, squat cans, maxi cans, lugs, aluminum bottles, new shaped cans, cans with edgy graphics and artistic designs	As long as consumers recognize that these new aluminum containers can be recycled like the standard aluminum can, the increased use of cans should improve overall recycling
4. Shift in imported beer from glass to aluminum cans due to the economic downturn	Increases in aluminum available for recycling, and reductions in glass
5. Reduction in bottled water consumption after years of strong growth. Bottled water reductions are a result of the weak economy and a growing backlash against bottled water due to the environmental impact of single serve/single use water bottles	Reduction in clear PET available for recycling, potential increase in PET recycling rates
6. Focus on sustainability and the environmental impact of packaging. Evian and Fiji Waters have set goals to reduce the carbon footprint of their water bottles. Nestlé Waters, Coca Cola, and Pepsi have all set sustainability targets. Smaller manufacturers are pushing "green" packaging innovations such as a 25% recycled content PET water bottle, 85% recycled content glass Vodka bottle, reusable bottles, water in paper cartons made from sustainably harvested forests, and juice and water in 100% polyactic acid (PLA)	Overall, this trend bodes well for recycling, recycled material markets, and use of recycled material in beverage containers. However, new green containers may contaminate recycling streams if not handled properly
7. Continued light-weighting of containers and lids to reduce the use of resources in beverage packaging	Reduced sales of primary resins, which in turn may result in reduced demand for recycled resins. Could also reduce the total amount (weight) of material available for recycling
8. Use of barriers, additives, fillers, and incompatible labels in plastic and glass beverage containers	Increases the cost of processing and reclaiming, lowers the value of recycled material, may result in contamination that reduces the quality of recycled material and prevents high-value end-uses

exception of distilled spirits,[3] the declines continued into the first quarter of 2009. Overall, the effect on recycling of these declines in sales will be felt over the next several months, as there will be fewer containers available to be recycled. With less containers sold, we may also see increases in recycling rates.

Within beverage markets, there are a number of trends that have been developing and strengthening over the last several years. **Table 7-2,** above, identifies eight trends and their potential impact on recycling and recycled material markets. **Table 7-3,** on the next page, provides summary information on non-alcoholic beverage sales for several beverage types. Total gallons sold declined by almost 2 percent between 2007 and 2008, due to declines in several of the larger beverage categories. The decline in total beverage volume in 2008 was the first volume decline on record. The decline has implications for container production – as fewer

[3] Industry analysts' note that premium distilled spirits are seen as an "affordable luxury" – consumers may cancel their expensive vacation, but still buy an expensive bottle of vodka. Of course, another plausible, but less positive explanation, is that consumers are drinking more distilled spirits to help cope with the economic recession.

Table 7-3
United States Liquid Refreshment Beverage Market – Million of Gallons (2006 to 2008)

Segment	2006	2007	2008	% Change 06/07	% Change 07/08	2006 Shares	2007 Shares	2008 Shares	Primary Container(s)
Carbonated Soft Drinks	15,103.6	14,688.0	14,232.6	-2.8%	-3.1%	50.1%	48.1%	47.5%	PET, aluminum
Bottled Water	8,253.5	8,823.0	8,672.9	6.9%	-1.7%	27.4%	28.9%	28.9%	PET
Fruit Beverages	4,020.1	3,899.5	3,928.2	-3.0%	0.7%	13.3%	12.8%	13.1%	PET, HDPE, #7, Glass
Sports Drinks	1,322.6	1,361.1	1,318.6	2.9%	-3.1%	4.4%	4.5%	4.4%	PET
Ready to Drink (RTD) Tea	760.9	875.1	859.3	15.0%	-1.8%	2.5%	2.9%	2.9%	Glass, aluminum, various plastics
Flavored and Enhanced Water	418.5	506.1	548.1	20.9%	8.3%	1.4%	1.7%	1.8%	PET, glass
Energy Drinks	242.7	335.7	365.9	38.3%	9.0%	0.8%	1.1%	1.2%	Aluminum
Ready to Drink Coffee	44.5	45.1	47.5	1.3%	5.3%	0.1%	0.1%	0.2%	Aluminum, glass
Total	30,166.4	30,533.6	**29,973.1**	1.2%	**-1.8%**	100.0%	100.0%	100.0%	

Source: Beverage World, State of the Industry Reports, April 2008 and April 2009.

containers are required to sell less volume. Reduction in container production results in less demand for virgin beverage container materials, reducing the price that buyers are willing to pay. This, in turn, reduces the price that buyers will pay for recycled beverage container materials.

Figure 7-3, on the next page, illustrates the shifts in percentage of total sales for the four major beverage material types in the AB 2020 program. Figure 1-3 illustrates the dramatic shift in sales shares between aluminum and PET, and the relative stability of glass. Although it is too early to tell, it appears that the relative shares of aluminum and PET may be stabilizing, after thirteen (13) years of aluminum declines. **Figure 7-4,** on page 7-11, illustrates the shifts in percentage of total containers recycled for the four major beverage material types. The shares of containers recycled follow similar trends to the shares of containers sold.

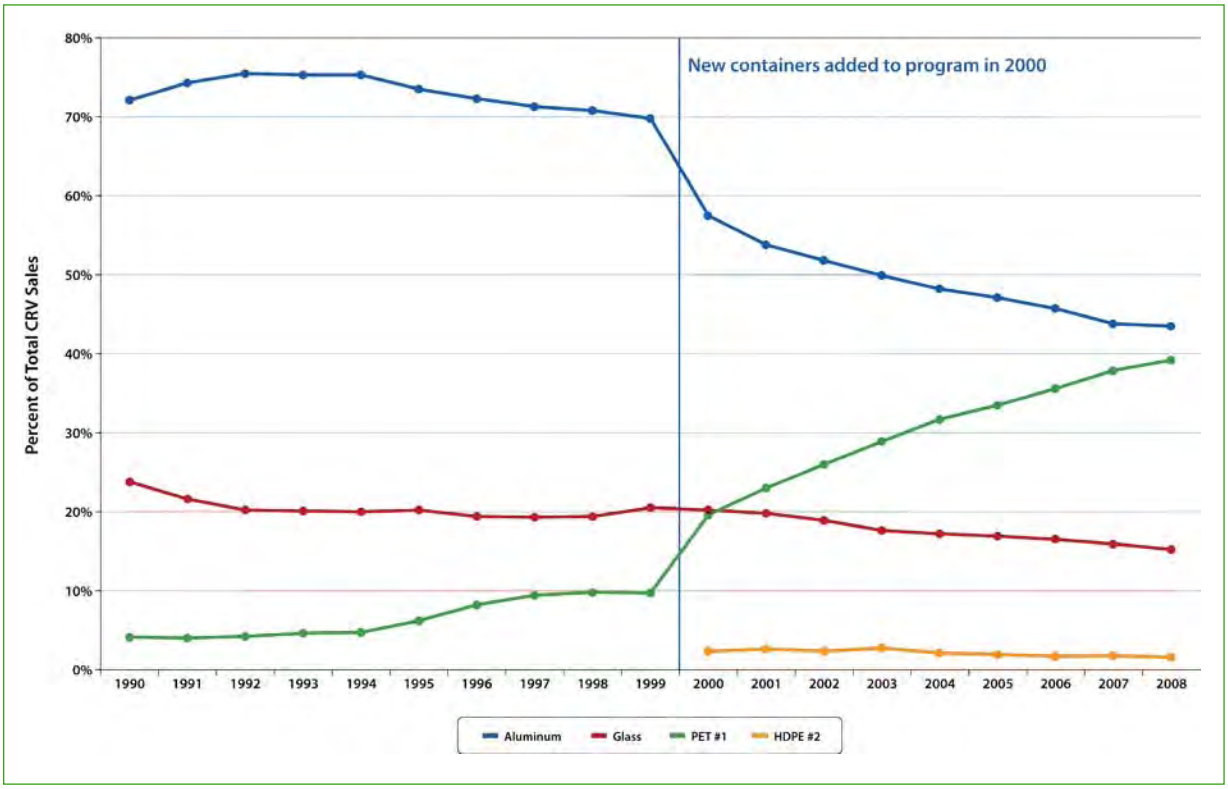
We discuss the implications of beverage industry trends for the four (4) major material types (aluminum, glass, PET, and HDPE) below. We also discuss polyactic acid (PLA) trends, a biodegradable plastic resin.

1. Aluminum

The vast majority of the almost 100 billion aluminum beverage containers sold annually in the United States are for beer and soft drinks. The total number of aluminum cans sold has not changed significantly over the last fifteen years – hovering at just above or below 100 million. In California, the number of aluminum beverage containers sold has been fairly consistent over the Recycling Program's history, at between 9 and 10 billion aluminum cans per year.

Over the last fifteen years, aluminum beverage cans have lost significant market share to plastic beverage containers, particularly for soft drinks. More recently, there has been a resurgence of interest in aluminum beverage packaging, primarily in non-traditional containers. New aluminum containers include skinny cans, squat cans, sleek

Figure 7-3
Percent of Total Beverage Container Sales, by Material Type (1990 to 2008)



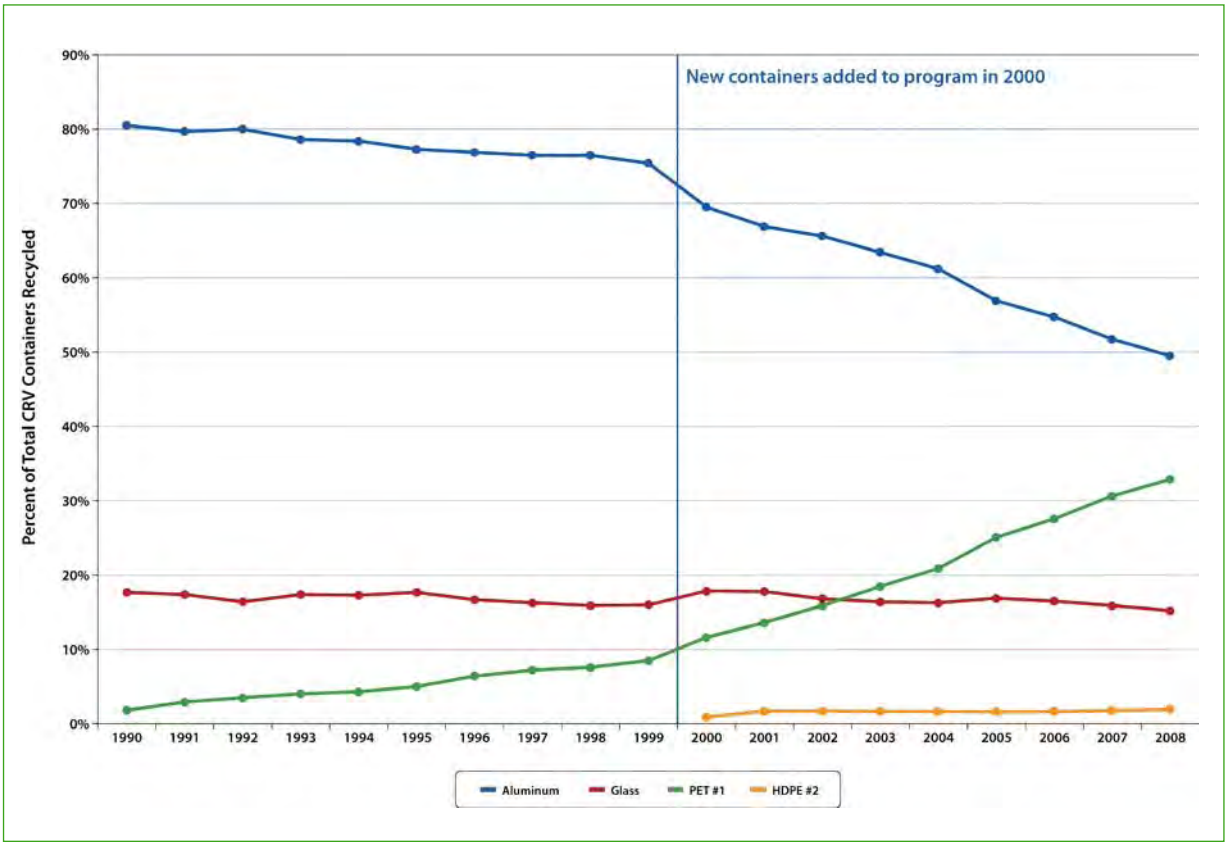
cans, giant cans, re-sealable cans, aluminum bottles, and lugs. A few beverage manufacturers are offering aluminum cans and bottles with graphic designs, including glow-in- the-dark cans and cans with professional artist designs. "New Age" and functional beverages such as energy drinks, nutritional supplements, and ready to drink teas are increasingly being marketed in "new" aluminum cans and/or bottles. These new aluminum beverage containers may help to counter the erosion of aluminum beverage market shares.

The reduced demand for beverages in general, due to the economic downturn, has also resulted in a decline in aluminum can production. The aluminum can market was down three to four percent in the first few months of 2009. Anecdotally, one processor was told in Spring 2009 that the aluminum mills have reduced their orders on can stock by one-half.

On the positive side for aluminum cans, sales of beer in aluminum cans are increasing relative to glass. Industry experts note that between high gas prices of 2008, and the economic downturn, there has been a switch from higher end beer in glass bottles, to less expensive beer in aluminum cans. More import beer is also switching from glass to aluminum cans.

There are significant environmental and economic benefits to recycling aluminum cans. Using recycled aluminum to produce cans saves 95 percent of the energy, and generates 97 percent less water pollution as compared to using primary aluminum. In addition, using one metric ton of recycled aluminum avoids the generation of ten metric tons of CO2 equivalents; reduces the use of

Figure 7-4
Percent of Total Beverage Containers Recycled, by Material Type (1990 to 2008)



caustic soda, aluminum fluoride, and lime; reduces the need to mine five metric tons of bauxite ore, and eliminates the generation of almost two metric tons of red mud byproduct. The Novelis recycling calculator shows recycling one billion aluminum cans reduces greenhouse gasses (CO_2 equivalents) by 119,780 metric tons, saves the equivalent of 321,248 barrels of oil, and saves 73,199 cubic meters of water.

2. Glass

The primary beverage in glass containers is beer. Typically, higher end, import, and craft beers are sold in glass bottles. Expenditures on beer and ale in Figure 1-2 show a drastic decline in the fourth quarter of 2008 and the first quarter of 2009. If, as industry analysts believe, this drop reflects both a reduction in overall consumption and a shift from premium beers (in glass bottles) to lower priced beers (in aluminum cans), this change could impact the availability of recycled glass during 2009.

Table 7-4, on the next page, provides U.S. Census Bureau data on glass container shipments in the United States from 2004 to 2008. In 2008, 60 percent of glass containers were for beer. Between 2007 and 2008, shipments of glass beverage containers, in terms of number of glass containers, decreased 12 percent, and shipments of glass beer containers decreased almost 4 percent. Between 2004 and 2008, total glass container shipments decreased 1.2 percent.

Table 7-4
Glass Container Shipments in the United States – Number of Glass Containers (2004 to 2008)

Product	2004	2005	2006	2007	2008
Food	6,468,336,000	6,329,664,000	5,889,312,000	5,526,720,000	5,519,088,000
Beverages	3,012,192,000	3,216,960,000	3,063,600,000	3,087,792,000	2,718,432,000
Beer	19,562,832,000	19,735,200,000	20,354,832,000	21,218,256,000	20,424,816,000
Liquor	1,072,656,000	1,154,160,000	1,135,008,000	1,114,704,000	1,153,728,000
Ready-to-drink alcoholic coolers and cocktails	1,219,680,000	1,217,952,000	980,352,000	1,061,568,000	1,160,496,000
Wine	1,811,808,000	1,856,160,000	1,885,104,000	1,900,656,000	1,924,992,000
Other*	1,362,672,000	1,754,352,000	1,468,800,000	967,824,000	1,179,792,000
Total	34,510,176,000	35,264,448,000	34,777,008,000	34,877,520,000	**34,081,344,000**

Source: U.S. Census Bureau, Glass Containers, Report M327G
*Other includes medicinal, cosmetic, chemical, health, household, industrial, and toiletry products.

3. PET

The primary beverage containers in PET are sodas and water. In addition, many of the specialty beverages, such as sports drinks, enhanced waters, and teas are sold in PET. Until 2008, PET has enjoyed steady growth in container sales, primarily due to bottled water.

The combined effects of the economy, and environmental backlash against bottled water produced the first reduction in bottled water annual sales. **Table 7-5,** on the next page, provides national sales data for bottled water from 1997 to 2008. Analysts had predicted that bottled water sales in 2008 would increase by close to 7 percent, but the final data shows a decline in gallons sold between 2007 and 2008 of 1.7 percent.

In years when regional data were available, the Pacific Region (essentially California) had significantly higher per capita bottled water consumption than nationally. We do not have data to assess whether California bottled water sales also declined in 2008, although total PET CRV sales in California were up 3.4 percent between 2007 and 2008. While California PET sales continued to increase compared to aluminum and glass CRV sales, the 2008 sales increase was the smallest since 1999.

One industry analyst believes that the virgin PET industry made unrealistic forecasts, and did not adequately recognize the declines in soft drink and bottled water sales. The virgin PET industry in North America is currently overbuilt, and is likely to suffer losses in 2009 as they readjust to changes in the economy, container light-weighting, and consumer preferences.

4. HDPE

Most HDPE containers are for non-food items such as detergent. The most common beverage in HDPE containers is milk, which is not included in the Beverage Container Recycling Program. In addition to milk, various juices, teas, and other beverages are in HDPE containers. HDPE containers tend to be larger, reflected in the low container per pound figure for 2007/2008 of 6 containers per pound.

The number of HDPE CRV beverage containers sold is significantly less than PET – with 340 million HDPE beverage containers sold during 2008, compared to 8.6 billion PET beverage containers sold during the same time period.

Table 7-5
Total United States Bottled Water Consumption (1997 to 2008)

Year	Millions of Gallons	Percent Change	Per Capita (Gallons)	Percent Change
1997	3,641.1		13.5	
1998	3,968.3	9.0%	14.7	8.9%
1999	4,411.2	11.2%	16.2	10.2%
2000	4,725.0	7.1%	16.7	3.1%
2001	5,195.7	10.0%	18.2	9.0%
2002	6,269.8	20.7%	20.1	10.4%
2003	6,806.7	8.6%	21.6	7.5%
2004	6,806.7	0.0%	23.6	9.3%
2005	7,539.1	10.8%	25.4	7.6%
2006	8,253.5	9.5%	27.6	8.7%
2007	8,823.0	6.9%	29.3	6.2%
2008	**8,672.9**	**-1.7%**	**28.5**	**-2.7%**

Source: Beverage World State of the Industry, 2008 and 2009.

At the national level, there has been less than a two percent increase in HDPE bottle production over four years, from 2004 to 2007. This likely reflects container light-weighting and increased use of products such as laundry concentrates in smaller bottles.

5. Polyactic Acid

Polyactic Acid or Polyactide (PLA) is a biodegradable plastic resin with properties and looks similar to PET.[4] It can be used in bottles, clamshells, fiber, and food service cutlery and dishes. There are two bottled water companies currently utilizing PLA in water bottles in California. Primo Water is selling 16.9 ounce (500 ml) bottles at Ralph's locations in Southern California, and Nature's Bottles is selling 500 ml PLA water bottles at closed venues within the State. Both of these bottles utilize Ingeo™ resin, produced by NatureWorks LLC. Currently, NatureWorks LLC is the only manufacturer of PLA in the United States, although other companies may begin producing this biodegradable resin in the next several years.

To this point, there are very few PLA bottles in the California marketplace; however, use of PLA in food packaging, including bottles, is likely to increase in the next several years. As a new resin in the marketplace, PLA poses many interesting questions, discussed briefly below.

The NatureWorks PLA facility in Blair, Nebraska, has capacity for 300 million pounds of PLA production annually. Approximately 43 percent of NatureWorks' production is sold in North America. Within North America, only 2 percent of PLA is currently used in bottles. In terms of pounds of material, this bottled amount of PLA is approximately equivalent to the total number of PS and PP containers sold in California in 2008. More common uses of PLA

[4] There are several types of bioplastic resins. This discussion is limited to PLA, as it is currently the primary resin utilized in bottles. Another bioresin with potential packaging applications is PHA, polyhydroxyalkanoate.

include fresh food clamshells; food service cups, bowls, plates, and cutlery; film; and to a lesser extent fiber. *Plastics News* estimates that in 2007, the U.S. demand for PLA was just over 90 million pounds. PLA demand is projected to increase to approximately 225 million pounds by 2012. By comparison, over 90 billion pounds of thermoplastic resins were produced in the United States in 2007.

PLA is currently produced from corn, sourced from within 30 miles of the Blair facility. The corn is harvested and transported to a corn wet mill, where the starch is separated, and the kernels are hydrolyzed to dextrose (corn sugar). The dextrose is piped to NatureWorks, where it undergoes a fermentation process to produce lactic acid. Lactic acid is converted to lactide, which is polymerized to form PLA. Researchers are also evaluating switch grass and sugar cane as feedstock for PLA.

The preferred end-of-life option for PLA bottles is chemical hydrolysis back into lactic acid, for processing back into new PLA. Recycled PLA can be recycled back into new bottles at up to 100 percent recycled content. Lactic acid produced from post-consumer PLA bottles can also be utilized in a number of other industrial processes. PLA can be composted in industrial composting facilities. It takes approximately 50 days for PLA to degrade into carbon dioxide, water, and humus. There are few industrial composting facilities available.

A key issue in the expansion of PLA bottles is the need for a collection system to handle the material. NatureWorks has instituted a buy- back program to purchase post-consumer PLA from MRFs and other recyclers. For now, most of the PLA generated in California will be in closed venues, where collection will be closely monitored. NatureWorks plans to ship collected PLA back to their Nebraska facility for chemical hydrolysis.

PLA has been on the market for several years. The resin was first used for bottles in 2004 by Biota, which is no longer in operation. As more food, milk, and water companies began to show interest in PLA, recyclers became increasingly concerned about the potential impacts of PLA on the PET recycling stream. PLA has a density similar to PET, and thus cannot be separated by the standard sink/float method. In 2006, a number of recyclers and environmental organizations in the United States requested that NatureWorks LLC place a moratorium on the use of Ingeo™ in bottles in order to address recycling issues.

Since 2006, NatureWorks has worked with recyclers, including the Association of Postconsumer Plastic Recyclers (APR), to address concerns related to PLA contamination of the PET recycling stream. PLA can be sorted using near infra-red (NIR) sorting technology with at least 97.5 percent effectiveness. PLA can result in hazing of clear PET resin at concentrations exceeding approximately 0.1 percent (1,000 ppm). This is significantly greater tolerance than PVC, which can contaminate PET loads at only 25 ppm.

The APR notes that “biopolymers could be a technical problem and economic impact for PET reclaimers” (APR, June 15, 2007). Many recycling facilities do not have NIR technologies, and manual sorting could be inefficient and potentially inaccurate. APR and NatureWorks are continuing to work on ways to reduce the potential impact of PLA on the PET recycling stream. Some questions will be answered by a Market Development and Expansion grant awarded to Future 500 in the 2008 grant cycle to develop and test a practical business system for sorting PLA and other materials from mixed recyclables and mixed plastics.

In August 2008, 20 companies, agencies, and organizations joined to create the Bioplastics Recycling Consortium to "develop an effective,

efficient and economical recovery system, and end-markets, for post-consumer bioplastic materials" (Plastics Recycling Update electronic newsletter, August 20, 2008).

NatureWorks is working to slowly develop and expand PLA bottles, recognizing the potential problems that more widespread introduction would have on existing recycling systems. While there is strong interest in the use of PLA in beverage containers, the company is committed to growing at a pace that will allow them to address recycling and end-of-life issues. It is difficult to predict how rapidly PLA will expand into the bottle market, but it is likely to be several years before it reaches levels significantly higher than the current low rates.

PLA is being used by Naturally Iowa for milk and drinkable yogurts, and by Noble Juice. Within the last year, bottled water companies in Chicago, Washington D.C., California, and Montreal, Canada have introduced PLA bottles. Scott Steele, vice president of development engineering for Plastic Technologies stated, "in today's market, it's [PLA] more expensive, but the thinking is over the next five to 10 years the bio-derived materials will be less expensive than the synthetic resins made from just oil because the price of oil is going to continue to increase on average as we draw more and more of it out of the ground. It's inevitable. So, at some point in time, these materials like PLA will have a home in our beverage business" (Beverage World, April 2009, p.77).

Beyond the technical issues, introducing PLA bottles into California presents policy and practical issues. The Beverage Recycling Program utilizes the twenty (20) year old Society of Plastics Industry (SPI) resin identification system (see Table 6-1, on page 6-1). Recycling rates, containers per pound, refund value, processing fees, and processing payments are all determined by resin type. Any resin, such as PLA, that does not fit within the first six codes is designated "7 – Other". Other plastics has become a catch-all category for any type of plastic or blend of plastic that does not fit within the norms. However, if PLA is to be handled properly and effectively, it must be kept separate from the remaining 7-Other plastics. The ASTM International (formerly the American Society for Testing and Materials) is currently reevaluating the resin coding system. This may be a precursor to establishing a unique code for PLA, as well as other bioresins.

Understandably, those in the PET recycling industry are concerned about the expansion of PLA beverage containers in the recycling stream. However, PLA is just one of many potential contaminants in the PET recycling stream. The bioplastics industry is taking a measured approach to PLA's expansion, and appears to be willing to work through technical and logistical concerns related to bioresins. Because it is plant-based, rather than oil-based, PLA offers potential carbon reduction advantages compared to standard plastic resins. As a result, beverage industry and recycling stakeholders likely will continue to work together to address PLA's potential problems, while embracing it's benefits.

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Appendix A

Literature References and List of Interviewees

Appendix A
Literature References and List of Interviewees

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